AECL Research

CALORIMETRY FOR A Ni/K$_2$CO$_3$ CELL

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SUMMARY

Experiments were conducted to assess the possibility of excess heat production in light-water electrolytic cells. The program comprised six basic experiments in which the magnitude of heat production was monitored calorimetrically over a period of several days. The first three experiments were conducted with a relatively high power (about 10 W). In the first two experiments, there was an indication that some significant recombination of the electrolysis gases was occurring; therefore, an experiment was conducted in which a hydrogen/oxygen recombiner catalyst was introduced to the electrolysis cell. No conclusive evidence of excess power generation was observed. These experiments were performed at power levels in excess of those recommended by Randell Mills, of Hydrocatalysis Power Corporation (HPC). The electrode assembly was modified by Randell Mills, and on the direction of HPC a second series of experiments was conducted at lower power (~1 W), this time with ambiguous results because of measurement difficulties. In the higher power experiments (#1, #2 and #3), no net excess or deficit energy was observed greater than experimental error. According to Mills, this result was consistent with operation at currents and voltages substantially higher than 1 mA·cm^{-2} and 2.5 V. The lower power experiments were done within the recommended current density and voltage, and according to Mills the expected excess heat would be about 0.25 W. Various methods of analysis were applied to the results of experiments #4, #5 and #6. Some of these analyses indicated possible excess heat at approximately this level. A model was developed to help elucidate the heat transfer characteristics of the system and hence give some insight to the energy balance data for low-power experiments.

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1. INTRODUCTION

Since the original claims of excess heat production in electrolytic cells by Pons and Fleishman, a considerable body of work has emerged, both experimental and theoretical. Fairly comprehensive reviews of the literature have been given recently.[1,2] While the original "excess heat generation" experiments concentrated on heavy-water solutions and noble metal cathodes, more recently several studies to investigate excess heat production with a K_2CO_3/light-water electrolyte in an electrolytic cell with a nickel cathode and platinum anode have been reported.[3-6]

The inventor of this work is Randell Mills, of Hydrocatalysis Power Corporation (HPC), who has reported excess power generation of 50 to 100% of the input electrical power with constant current and as high as 10 to 15 times input power with pulsed current.[6] Our work aimed to repeat the experiments of Randell Mills, to determine whether excess heat generation was observable in our experimental system. The experimental program was therefore conducted in close collaboration with personnel from HPC.

2. EXPERIMENTAL

2.1 Materials and Supplies

Potassium carbonate was purchased from the Aldrich Chemical Company and certified to be 99.99% pure. Nickel wire was obtained from Alfa Chemicals and all gases used came from Linde. Distilled 18 MΩ·cm deionized water was used for making up the electrolyte solution. To ensure no contamination of the electrode system all glassware was washed in HCl, rinsed copiously with distilled water and dried overnight in a vacuum oven at 200°C. In the first experiment, the cathode and anode were dipped in concentrated HCl for one hour, and then rinsed thoroughly with distilled de-ionized water. In subsequent experiments, the anode was treated as in experiment 1, but the cathode material was immersed in a 0.57 M K_2CO_3/3%H_2O_2 solution for thirty minutes, and then rinsed with distilled de-ionized water.[7] Once the cell had been cleaned all manipulations were carried out using nylon gloves. At no time were the electrodes immersed in electrolyte solution without current flowing. In experiment #3, AECL wetproofed catalyst # QA87-204 was inserted into the top of the electrolysis cell, to ensure complete recombination of all of the electrolysis gases.

2.2 Cell Design

To reproduce the conditions of Mills' experiments, a new cell was designed and constructed, as shown in Figure 1. The cell volume was approximately 1200 mL. The electrode support was constructed from polypropylene. The central cathode comprised 100 m of 0.5 mm nickel wire. Around the outer section of the electrode support, six 4-mm diameter glass rods were positioned (~1 cm from the central cathode) to support the 1.5-mm diameter platinum wire anode. The ratio of cathode to anode surface area was approximately 20:1. For the first experiment the electrode wires were connected directly to the power supply; for subsequent experiments the anode and cathode wires were clipped at the point of exit from the electrolyte solution and replaced by #16 American Wire Gauge (AWG) copper wire, to minimize resistive losses. The cell was stirred with a magnetically coupled glass stirring-rod assembly fitted with a Teflon paddle. Electrolysis gases were passed from the cell via the vent tube and a molecular sieve drier to a Tylan thermal mass flow transducer, to determine the quantity of gas being released from the cell. The mass flow transducer was calibrated using a stoichiometric (2:1) H_2/O_2 gas mixture against a soap bubble meter. Gases emitted from the electrolysis cell were sampled and analyzed by gas chromatography. The ratio of hydrogen to oxygen in the effluent from the cell was found to be 2.14:1.00.

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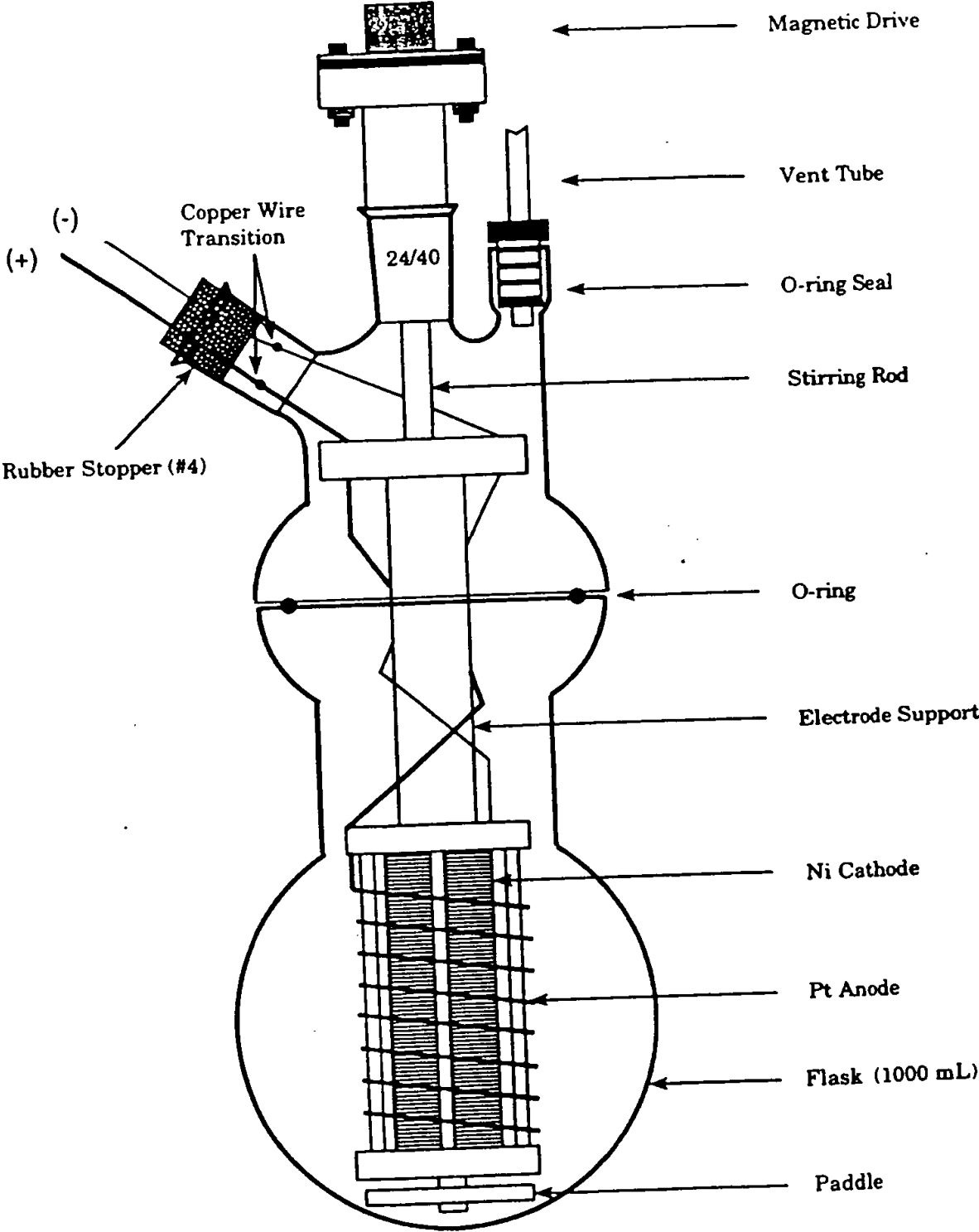
Magnetic Drive

(-)

(+)

Copper Wire
Transition

24/40

Vent Tube

O-ring Seal

Stirring Rod

Rubber Stopper (#4)

O-ring

Electrode Support

Ni Cathode

Pt Anode

Flask (1000 mL)

Paddle

Figure 1 - Electrolysis Cell

2.3   Temperature Control

A temperature-controlled enclosure was employed for these experiments, to ensure that fluctuations in the ambient temperature would not adversely affect the experimental results. The entire experimental system is shown in Figure 2, and a schematic illustrating the system water flow is shown in Figure 3. The ambient temperature in the enclosure was controlled by heat lamps, a cooling coil and a fan to circulate the air in the enclosure (minimum 2.5 $m^3 \cdot h^{-1}$).

2.4   Operating Conditions

The electrolysis cell was immersed in water inside the stainless-steel dewar and surrounded by a coil of copper tubing. Water was circulated through this coil to absorb heat from the cell when electrolysis was occurring. The experiment was designed in such a way that, for a given current, the theoretical heat generation was calculated and the inlet temperature of the water flowing through the copper coil adjusted such that the outlet temperature from the cooling coil would be approximately equivalent to the dewar temperature and the ambient temperature of the enclosure.

The ambient temperature and the dewar temperature were chosen as 35 to 37°C. The inlet temperature of water to the cooling coil was approximately 22 to 24°C, and the outlet temperature was approximately equal to the dewar temperature. The water circulating in the cooling coil was stored in a 25 L reservoir tank and passed through a constant temperature water bath (to obtain a temperature of 22 to 24°C) via insulated lines and a heat exchanger (to further ensure the appropriate inlet temperature) to the cooling coil in the dewar. The flow rate of water was controlled and monitored by an HPLC pump; as a check on the flow rate, the water was also passed to a weighing tank, which, when full, emptied into a drain tank equipped with a level controller and recycle loop to re-fill the water reservoir. In this way, the experiment could be run continuously with minimum operator intervention.

System temperatures, exit gas flow rate, water flow rate, voltage and current were all monitored and stored using a Data Translation DT2805 computer data acquisition system linked to a PC. A computer program was written for data acquisition and signals were recorded.

2.5   Instrumental Uncertainties and Estimation of Experimental Errors

Components of the experimental system were calibrated and where possible the experimental uncertainty associated with each of the following measurements was established or, where necessary, calculated:

i.   - Voltage, current and hence input power.
ii.   - Temperature measurements.
iii.   - Flow rate of water to cooling coil.
iv.   - Power from recombination of gases.
v.   - Resistive losses in lead wires.
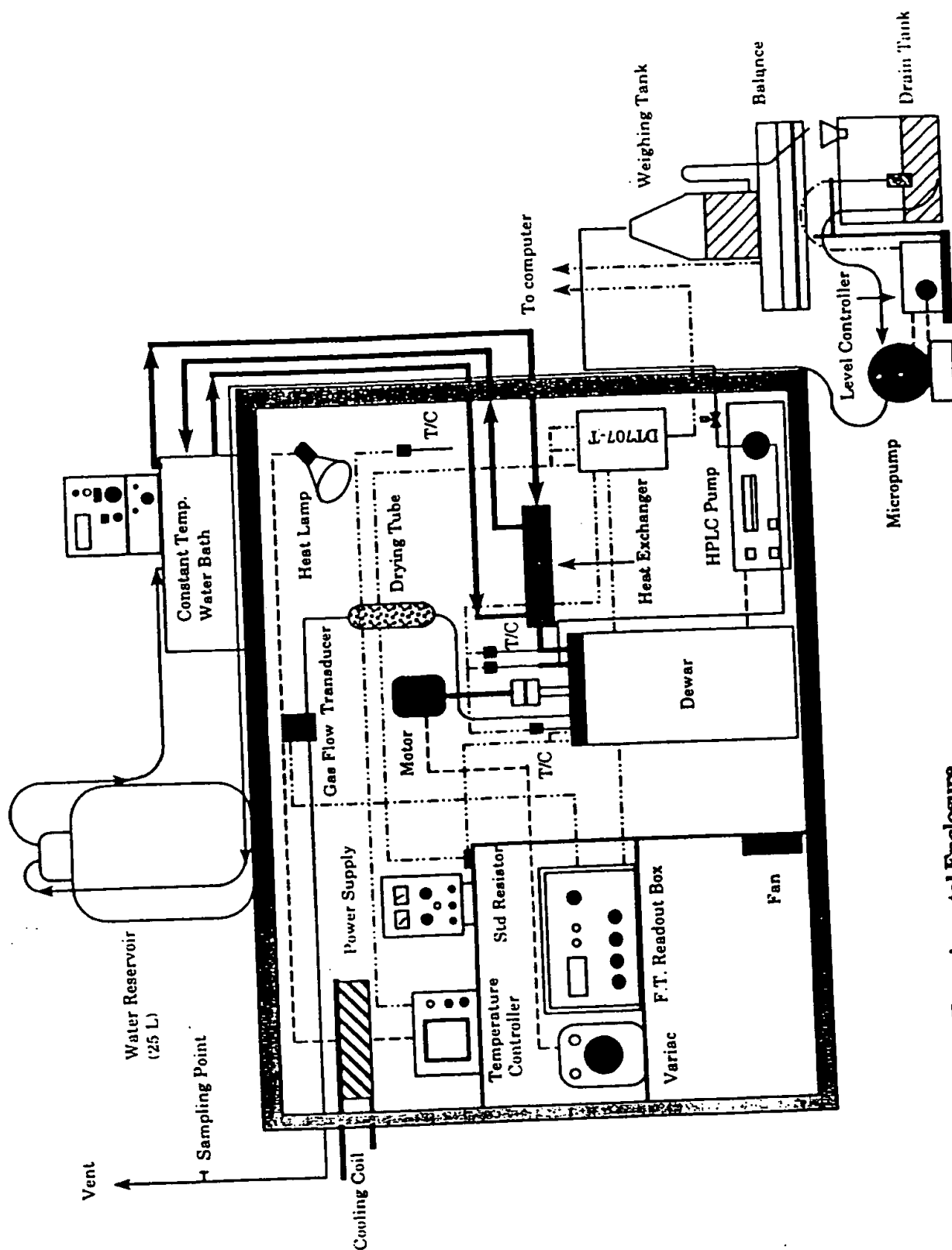vi.   - Effect of ambient temperature on dewar temperature.
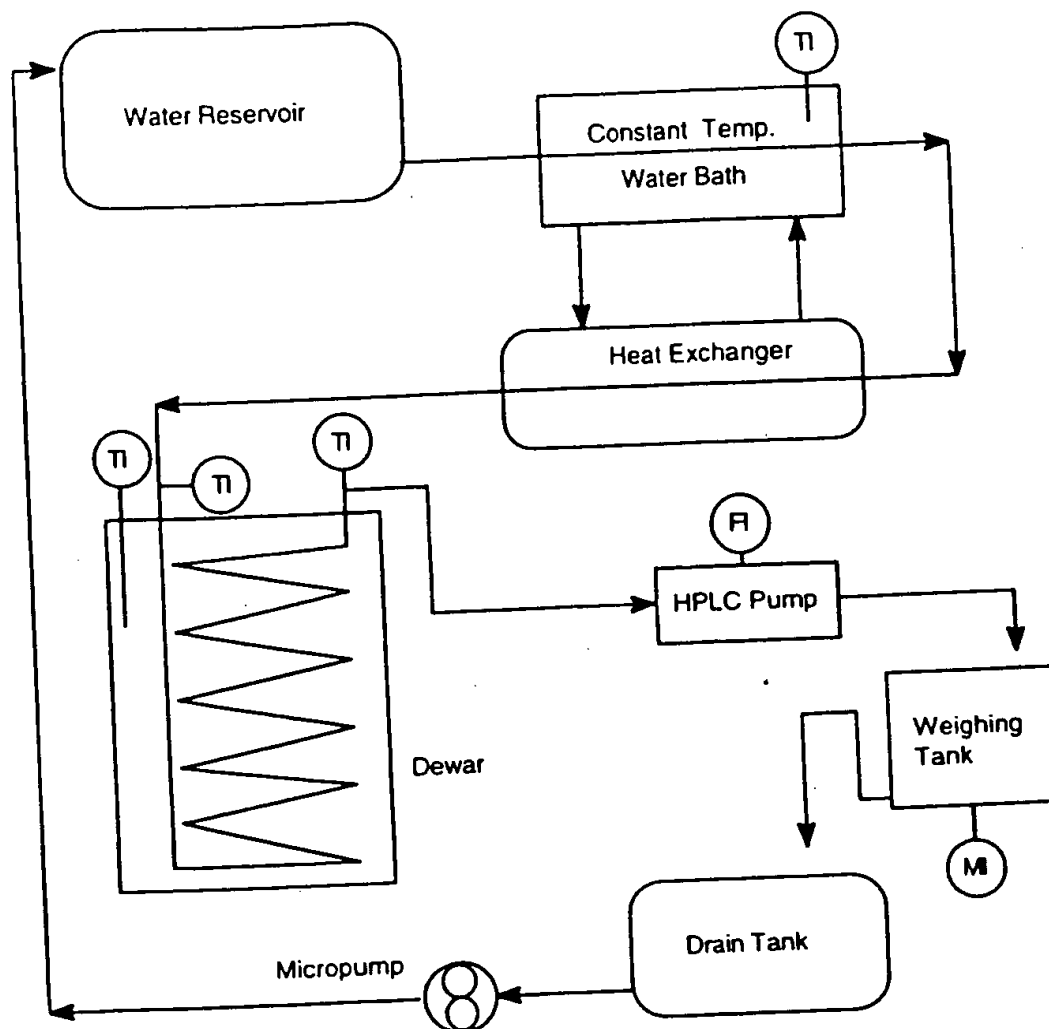
Figure 2 - Experimental Enclosure

Figure 3 - Water Flow Diagram

i.   Voltage and Current Measurements

The voltage and current were recorded with the computer data acquisition system. The DT2805 board A/D subsystem has an accuracy of ± 0.1% FSR and a precision of ± 1 LSB (0.025%). The computer readout was compared with a 4.5 digit Fluke 8060A electronic multimeter. All readings were in agreement to four significant figures. The voltage was measured across supply wires near the entry to the cell, as shown in Figure 4. The current was obtained by measuring the voltage drop across a 10 W, 100±1 mΩ resistor. The exact resistor value was obtained using the voltage drop measured by the computer and the current flowing through the resistor as measured by a Fluke 8060A and a Fluke 77 multimeter. The resistor value was found to be 103.8 ± 2.3 mΩ over the operating range. The input power was calculated from:

$$Power = Voltage \times Current$$

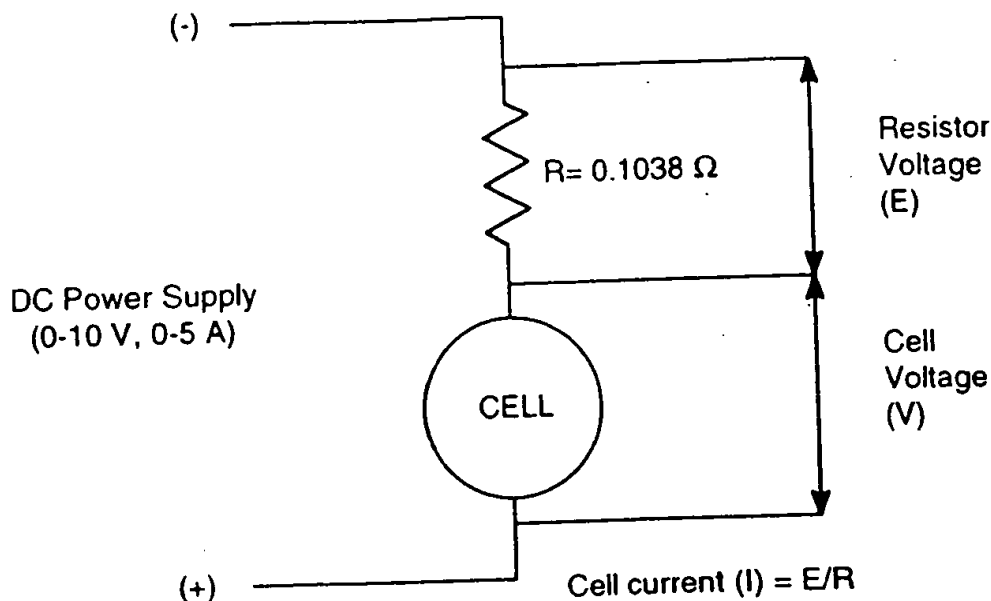The error associated with the calculation of the input power is estimated to be approximately ±2.2%.

Figure 4 - Cell Electrical Measurements

ii.   Temperature Measurements

A Data Translation DT707-T screw terminal panel was used to make all the connections to the Data Translation DT2805 data acquisition board. The DT707-T is equipped with a thermocouple cold-junction compensation circuit (CJC). The CJC circuit provides a means by which to determine the temperature of the DT707-T board. The computer program was written to permit compensation for errors by the cold-junction thermocouple formed at the DT707-T. The CJC was calibrated following the procedure described in the user manual.

Since the board was located inside the test enclosure, the temperature of the board was used as a measure of the ambient temperature in the enclosure. The water inlet, outlet, and dewar temperature were measured using copper-constantan thermocouples (Type T, Limits of error ± 1°C). The temperature difference between the water inlet and outlet was used in the calculation to determine the power output of the cell. Small variations in the temperature measured by two independent thermocouples can occur. To eliminate this type of potential repeatability error, the two thermocouples used to measure the water inlet and outlet temperature were matched so that both thermocouples indicated the same temperature when immersed in an ice bath or in boiling water to within 0.1°C.

The thermocouples were calibrated and the error associated with ΔT measurements at the input and output of the cell were found to be within ±0.35%.

iii.   Flow Rate of Cooling Water

The flow rate of cooling water was controlled with the HPLC pump. The water was passed through the cooling coil and then to a reservoir situated on top of a balance. The mass of water in the reservoir was monitored (using the computer), and after approximately 100 minutes the average flow rate was calculated and compared with the flow rate reading recorded with the pump. The pump value for cooling-water flow rate was determined to be accurate to ±0.3%. The output power from the cell was calculated using the mass reading from the balance. If the balance reading fell below 98% of the pump reading, then the pump average flow was used to calculate the output power.

The power derived from the electrolytic cell (P_{cool}) was calculated according to the following equation:

$$P_{cool} = QC_p\Delta T$$

where:

C_p is the heat capacity of liquid water and taken as 4.184 $J \cdot g^{-1} \cdot K^{-1}$,

ΔT is the difference in temperature between the inlet and outlet of the cooling coil, and

Q is the flow rate of water to the cooling coil in $g \cdot s^{-1}$ (as determined from the balance).

The limit of accuracy attainable for power out measurements is estimated to be within 2%.

iv. Power from Recombination of Electrolytic Gases

Recombination of hydrogen and oxygen produced on electrolysis is possible, and therefore all gases being released from the cell must be measured and accounted for. The power associated with recombination may be calculated from:

$$P_{rec} = \Delta H_{300\,K} (Q_{calc} - Q_{meas}) \times \frac{2}{3} \times \frac{1}{22.4}$$

where:

P_{rec} = the power added to the system from recombination of hydrogen and oxygen,

$\Delta H_{300\,K}$ = $- 285.771$ $kJ \cdot mol^{-1}$,[8] enthalpy of formation of H_2O (g) from H_2 and O_2 in their standard states at 298 K and 101.325 kPa,

Q_{calc} = gas flow rate ($L \cdot s^{-1}$) from the cell assuming no recombination,

Q_{meas} = actual exit dry gas flow rate ($L \cdot s^{-1}$) as measured experimentally,

2/3 accounts for stoichiometric ratio of hydrogen and oxygen, and

22.4 L is the volume occupied by one mole of a gas at STP.

The instrumental error on the mass flow transducer used for gas flow measurements is estimated to be ± 1%.

v. Estimation of Resistive Losses in Lead Wires to the Cell

Resistive losses in the lead wires to the cell were calculated based on the following data:

Platinum wire #16 AWG has a resistive loss of 0.000764 $\Omega \cdot cm^{-1}$ at 18°C.[9] The length of wire from the cell to the power supply was approximately 31 cm; therefore, total resistance was approximately 0.024 Ω. For nickel wire, #16 AWG, the resistance is given as 0.00381 $\Omega \cdot cm^{-1}$.[9] The length of nickel wire used was ~39 cm; therefore, the total resistance in the nickel wire is estimated to be 0.15 Ω. Power associated with these two resistances may be calculated from:

$$P_{res} = I^2 R$$

Which, for experiment #1, was:

$$P_{res} = I^2(R_{Pt}+R_{Ni})$$
$$= (2.822 \text{ A})^2 \times (0.024 \text{ }\Omega+0.15 \text{ }\Omega)$$
$$= 1.38 \text{ W}$$

To minimize these losses, the platinum and nickel lead wires were replaced with #16 AWG copper wire. The resistance of this wire is documented as 0.000132 Ω-cm^{-1}.[9] Using 39 cm of copper wire for each electrode with a current of 2.822 A, the total resistive losses drop to 0.082 W. Therefore, copper was substituted for the nickel and platinum lead wires after the first experiment. In experiments #4, #5, #6, and in the calibration runs Cal1W1 and Cal1W2, the current never exceeded 1 A; therefore, the resistive losses in the copper lead wire were always less than 5.15 x 10^{-3} W.

vi. Estimation of Fluid Frictional Power in a Pipe

The power loss due to the friction of the cooling water flowing in the cooling tube (P_{fr}) may be estimated, assuming the flow is laminar. Using the Hagen-Poiseuille equation for frictional head loss (Δp) in a circular tube:

$$\Delta p = \frac{128 \text{ }\mu LQ}{\pi D^4}$$

Assuming a 10 m long tube (L) with a 2 mm inside diameter (D) and about 10 g·min^{-1} pure water flowing inside (Q), the head loss is:

$$\Delta p = \frac{128 \times 10^{-3} \frac{kg}{m \cdot s} \times 10 \text{ m} \times \frac{10^{-5} \text{ m}^3}{60 \text{ s}}}{\pi \times (0.002 \text{ m})^4}$$
$$= 424 \text{ Pa}$$

and the power is:

$$P_{fr} = Q\Delta p$$
$$= \frac{10^{-5} \text{ m}^3}{60 \text{ s}} \times 424 \text{ Pa}$$
$$= 7.1 \times 10^{-5} \text{ W}$$

Thus, for this situation, the frictional power is negligible.

vii. Estimation of Stirring Power Loss

Power added to the system by stirring may be estimated from the following correlations for the dimensionless power number (N_p):[10]

$$N_p = \frac{80}{R_e} \text{ at low Reynolds number}$$
$$= 6 \text{ at high Reynolds number}$$

where:

$$N_p = \frac{P_{st}}{\rho N^3 D^5}$$

$$Re = \frac{D^2 N \rho}{\mu}$$

In this case, the impeller was 40 mm diameter (D) and rotating at 2 rev·s^{-1} (N) in electrolyte (ρ = 1000 kg·m^{-3}, μ = 10^{-3} kg·m^{-1}·s^{-1}). Thus the power added by stirring was between:

$$P_{st} = \frac{80 \mu}{D^2 N \rho} \rho N^3 D^5$$

$$= 80 \mu N^2 D^3$$

$$= 80 \times 10^{-3} \frac{kg}{m \cdot s} \times (2s^{-1})^2 \times (0.04 \ m)^3$$

$$= 2 \times 10^{-5} \ W$$

and:

$$P_{st} = 6 \rho N^3 D^5$$

$$= 6 \times 10^3 \frac{kg}{m^3} \times (2s^{-1})^3 \times (0.04 \ m)^5$$

$$= 5 \times 10^{-3} \ W$$

Therefore, in the worst-case scenario the power added to the cell from stirring is about 5 mW.

2.6   Estimation of Total Power In and Total Power Out of Cell

The total power delivered to the cell has several potential sources and may be calculated from:

$$P_{tot,in} = P_{e,in} + P_{rec} + P_{fr} + P_{st}$$

where:

$P_{e,in}$ is power from voltage and current delivered to the cell,
P_{rec} is power from recombination of electrolysis gases,
P_{fr} is power from the frictional pressure drop in the cooling coil, and
P_{st} is power produced from the stirrer.

The total electrical power provided to the cells is simply:

$$P_{e,in} = IV$$

and the power used for the electrolysis reaction is:

$$P_{elec} = IV_0$$

where:

V = the total cell voltage,
V_0 = the hydrogen/oxygen thermoneutral cell voltage (1.48 V), and
I = the cell current in A.

P_{rec}, P_{fr} and P_{st} are calculated as shown in Section 2.5.

The total output power from the cell can also be estimated:

$$P_{tot,out} = P_{cool} + P_{elec} + P_{res} + P_{cond}$$

where:

P_{cool} is the portion of input power used to heat up the cooling water,

P_{elec} is the portion of input power used in electrolysis of water,

P_{res} is the resistive losses in the lead wires, and

P_{cond} is the portion of power used to evaporate the water that is carried out (as vapor) with the evolved gases.

In a similar fashion the total input energy and output energy can be defined as:

$$E_{tot,in} = E_{e,in} + E_{rec} + E_{fr} + E_{st}$$

and,

$$E_{tot,out} = E_{cool} + E_{elec} + E_{res} + E_{cond}$$

or:

$$E_{tot,in} = \int_{t_1}^{t_2} P_{e,in}\, dt + \int_{t_1}^{t_2} P_{rec}\, dt + \int_{t_1}^{t_2} P_{fr}\, dt + \int_{t_1}^{t_2} P_{st}\, dt$$

and,

$$E_{tot,out} = \int_{t_1}^{t_2} P_{cool}\, dt + \int_{t_1}^{t_2} P_{elec}\, dt + \int_{t_1}^{t_2} P_{res}\, dt + \int_{t_1}^{t_2} P_{cond}\, dt$$

2.7   System Calibration

The cell was calibrated using a 1 Ω resistor as an immersion heater. This resistor was installed on the electrode assembly and the cell filled with de-ionized distilled water. The resistor was connected to the power supply using 1 m of #16 AWG copper lead wires. The ambient temperature was set at 37°C and the inlet power set to the desired value. After all the temperatures and process conditions were stabilized, the water flow rate and inlet temperature were adjusted such that the power output matched the power input.

Once the power input and output were matched, the data acquisition system was reset and the system was monitored over an extended period of time, to determine whether there was any drift, offset or fluctuation in the input or output power of the system. The mean input and output power for 7 W and 15 W calibration studies, along with standard deviations of these measurements, are shown in Table 1.

Temperature measurements were recorded during the resistance heater power calibration studies, to determine whether small fluctuations in the ambient temperature had any effect on the dewar temperature or the recorded outlet temperature. There was no significant effect of variations in the ambient temperature on the dewar temperature, providing the fluctuations in the ambient temperature were kept to a minimum. Mean temperatures with standard deviation data are listed in Table 1. Similar experimental data are also listed in Table 1 for the pump calibration and the mass-flow transducer calibration.

Table 1 - Statistical Analysis of Calibration Data

Quantity	Mean	Standard Deviation	% Error
Input Power (7 W)	7.35	0.0123	0.17
Output Power (7 W)	7.49	0.1673	2.22
Input Power (15 W)	14.56	0.0391	0.26
Output Power (15 W)	14.76	0.2603	1.78
Pump Flow (0.12 g·s^{-1})	0.12	0.0004	0.28
Pump Flow (0.24 g·s^{-1})	0.24	0.0007	0.29
Vent Gas Flow Rate (mL·min^{-1})	26.53	0.14	0.52

3. RESULTS

Experiments #1,#2 and #3

In all of these experiments, 1200 mL of 0.57 M K_2CO_3 solution was placed in the electrolysis cell. The cell current was set at 0.25 A before the electrode assembly was immersed in the electrolyte, in accordance with the directions from Mills' Laboratory.[7] After inserting the electrode and sealing the cell, the current was increased to 2.822 A, to give a current density of 1.8 mA·cm^{-2}. The system was operated until the dewar temperature and outlet temperature from the copper coil surrounding the cell were stabilized.

The voltage corresponding to this cell current was 4.93 V, which resulted in an input power of 13.86 W being delivered to the cell. Of this 13.86 W, it is expected that 4.177 W would be used for electrolyzing water (assuming electrolysis voltage equals 1.48 V). The remainder of the power would be used to increase the temperature of the water circulating around the electrolysis cell in the copper coil. The basic energy balance data for experiments #1, 2 and 3 were computed as shown in Table 2.

The surface area of the cathode was about 1500 cm^2. The current density recommended by Mills was less than 1 mA·cm^{-2}, thus the recommended current was about 1.4 A. The actual current was approximately twice this value. Furthermore, Mills recommended that the cell voltage not exceed 2.5 V. Using the cell resistance calculated from the voltage and current of experiment #1, the recommended input parameters were a cell current of 1.4 A, a cell voltage of 2.1 V and an input power of 2.94 W .

Table 2 - Data from Experiments #1, #2 and #3

Expt. #	Electrical Energy In (W·h)	Thermal Energy Out (W·h)	Total Electrolysis Energy (W·h)	Measured Gas Released (L)	Theoretical Gas Production (L)
1	723.6	517.1	212.6	67.59	89.80
2	1154.5	685.3	481	184.25	203.15
3	1196.7	1203.97	.	.	.

The total input energy to the cell may be calculated as follows for experiment #1:

$$E_{tot,in} = E_{e,in} + E_{rec} + E_{fr} + E_{st}$$
$$= 723.6 \text{ W·h} + 52.4 \text{ W·h} + 0 \text{ W·h} + 0.26 \text{ W·h}$$
$$= 776.3 \text{ W·h}$$

$$E_{tot,out} = E_{cool} + E_{elec} + E_{res} + E_{cond}$$
$$= 517.1 \text{ W·h} + 212.6 \text{ W·h} + 70.25 \text{ W·h} + 2.91 \text{ W·h}$$
$$= 802.7 \text{ W·h}$$

The first experiment was designed to identify potential operating problems. Recombination appeared to play a significant role in the overall energy balance; therefore, it was concluded that the absolute quantity of gas evolved from the system should be monitored very closely, and that particular attention should be paid to all potential leaks. Another possible source of error was resistive losses in the lead wires.

The quantity of water evaporated from the cell and adsorbed in the trap for experiment #1 was calculated by weighing the molecular sieve trap before and after the experiment. The mass of liquid adsorbed on the molecular sieve was recorded as 4.3 grams or 0.24 moles of water (which corresponds to a saturation temperature of about 40°C in the gas leaving the cell). The enthalpy of vaporization is approximately 44 $kJ \cdot mol^{-1}$.

From the integrated data there would appear to be an overall energy gain of 26.4 W·h in experiment #1, which would translate to approximately 0.5 W of power, or 3% of the input power. It is believed that, under the conditions of the experiment, this figure is within experimental error. According to the experiments of Mills et al., excess power to the extent of 1 $mW \cdot cm^{-2}$ of cathode surface would be expected, which in this experiment would translate to 1.5 W of power or an energy of 76.4 W·h.

In experiment #2, the reaction system was modified slightly, to minimize all potential power losses, ensure that there were no gas leaks and ensure that the measurement of gas evolution was indeed accurate. Further advice was sought from Randell Mills, of HPC, concerning operating conditions.

Prior to beginning the second experiment, a new cathode was rolled as described in Experiment 1. The cathode was then soaked in K_2CO_3/3% H_2O_2 as described in section 2. The platinum wire was soaked in HCl, rinsed in distilled deionized water and installed in the electrode assembly. A 0.57 M solution (1200 mL) of K_2CO_3 was placed in the electrolysis cell, the current turned on at 0.25 A and the electrode assembly immersed in the electrolyte. Since the nickel and platinum lead wires were replaced with copper, the overall cell resistance was reduced; therefore, for a current of 2.822 A the voltage required dropped to approximately 3.5 V. Hence, the input power to the cell was in the region of 9.87 W.

The surface area of the cathode was about 1500 cm^2. The current density recommended by Mills was less than 1 $mA \cdot cm^{-2}$, thus the recommended current was about 1.4 A. The actual current was approximately twice this value. Furthermore, Mills recommended that the cell voltage not exceed 2.5 V. Using the cell resistance calculated from the voltage and current of experiment #1, the recommended input parameters were a cell current of 1.4 A, a cell voltage of 1.83 V and an input power of 2.57 W

Approximately 9% of the expected electrolysis gas was missing, implying that this portion of gas had recombined. The energy associated with this recombination is calculated as 44.5 W·h. In addition, a small fraction of water vapor was carried from the cell in the effluent gas stream and adsorbed in the molecular sieve trap. The quantity of water adsorbed in the trap was calculated by weighing the molecular sieve trap before and after the experiment. The mass of liquid adsorbed on the molecular sieve was recorded as 11.7 grams or 0.65 moles of water (which corresponds to a saturation temperature of about 40°C in the gas leaving the cell - as in experiment #1). The energy lost from the system as a result of evaporation was calculated as 28.6 kJ or 7.9 W·h.

Summing up all the appropriate input terms for experiment #2:

$$E_{tot,in} = E_{e,in} + E_{rec} + E_{fr} + E_{st}$$
$$= 1154.5 \text{ W·h} + 44.5 \text{ W·h} + 0 \text{ W·h} + 0.578 \text{ W·h}$$
$$= 1199.7 \text{ W·h}$$

Similarly, the total power released from the cell, neglecting heat loss, can be obtained:

$$E_{tot,out} = E_{cool} + E_{elec} + E_{res} + E_{cond}$$
$$= 685.3 \text{ W·h} + 481 \text{ W·h} + 9.4 \text{ W·h} + 7.9 \text{ W·h}$$
$$= 1183.6 \text{ W·h}$$

The energy difference is therefore 16 W·h (or 0.14 W), or 1.4%. This energy is, however, apparently lost from the system, and we suspect that this "loss" reflects the operating constraints of the system.

One of the areas of concern in this type of experiment is accounting for energy added to the system from recombination of the electrolysis gases. One way to eliminate any uncertainty concerning recombination would be to recombine all of the electrolysis gas in a closed reactor. In order to do this another experiment was conducted identical to Experiment #2, but with a recombiner catalyst housed in the top portion of the electrolysis cell. The electrolysis cell was run under a slight excess of oxygen (2 mL·min^{-1}) to eliminate potential explosion hazards.

The difference in input and output energy can be computed as before:

$$E_{tot,in} = E_{e,in} + E_{rec} + E_{fr} + E_{st}$$
$$= 1196.7 \ W·h + 0 \ W·h + 0 \ W·h + 0.561 \ W·h$$
$$= 1197.3 \ W·h$$

Similarly, the total energy released from the cell can be obtained:

$$E_{tot,out} = E_{cool} + E_{elec} + E_{res} + E_{cond}$$
$$= 1203.97 \ W·h + 0 \ W·h + 9.44 \ W·h + 0 \ W·h$$
$$= 1213.4 \ W·h$$

Net energy production during the recombination experiment was therefore 16.1 W·h, which translates to 0.13 W or 1.3% of input power. This quantity of energy falls within the experimental error expected for this experiment. There would therefore not appear to be any real evidence for excess heat production in the large-scale cell as constructed and operated in this laboratory.

On further consultation with Randell Mills, it was agreed that the cell assembly would be sent to HPC, where a new anode and cathode would be fitted, the cell returned to AECL and a fourth experiment conducted. HPC provided analysis of AECL's departures from their protocol concerning operating conditions necessary for the observation of excess heat in a light-water electrolytic cell:

1. The cathode should not be electrolyzed above 2.5 V nor 1 amp current.
2. Rigorous cleaning steps as described in Section 2 should be conducted.
3. Back pressure in the cell must be avoided at all costs: at a partial pressure of 0.1 atm hydrino molecules, the catalytic reaction reaches equilibrium. Further tests with open cells demonstrated the higher the back pressure on an open cell, the less excess heat was observed for that cell.

These points were noted and the experimental system modified accordingly.

Experiments #4, #5 and #6

The electrodes were assembled at HPC using the AECL electrode holder. The cathode was constructed from three 30.76 m lengths of 0.38 mm nickel (Alfa Chemicals); the 1.5 mm diameter platinum wire anode was that of experiments #1, #2 and #3. The surface area of the cathode was 1 101.4 cm^2. To ensure that the conditions of the experiment were adhered to, the cell voltage was set at 2.4 V. With this voltage the current never exceed 1 A. Assuming no excess power generation, the actual power expected was in the region of 1 W. In order to detect this relatively small amount of power, the cooling water flow rate was reduced significantly, to ensure that the temperature change of the cooling water was high enough to be recorded accurately.

According to HPC, this electrode system was expected to produce a maximum of 1 mW·cm^{-2} of the cathode which carried a current of approximately 1 mA·cm^{-2}. The cathode surface area was 1100 cm^2 and it was estimated that approximately half was exposed to the electrolyte. Thus, the predicted excess power was approximately 0.25 W which, with this experimental arrangement, would amount to 25% excess power.

Experiment #4 was an open cell, whereas in experiments #5 and #6, the cell used for experiment #4 was fitted with the same recombiner catalyst used in experiment #3. These two experiments were

then run in the same way as experiment #3, except that in experiment #6 the water cooling was turned off and the run was quite short.

Calibration Runs

At the end of experiment #6, the power was turned off, but the experiment was allowed to continue in order to study the transfer of heat between the dewar and the surroundings. Following this, two low-power calibration tests were performed with a 1 Ω resistor arranged in the same way as the previous calibrations. In addition, a number of different heat transfer tests were done on the dewar. (These calibration runs were clearly desirable for an experimental setup that was designed for power measurements in the 10 W range, but was now being used for experiments in the 1 W range.)

The following tables (Table 3a, 3b and 3c) lists the experimental sequence of events for the last two experiments and the two calibration runs. The data in Tables 3b and 3c were obtained by averaging 10 readings starting at the times indicated.

Table 3a - Procedure for Experiments #5 and #6 and Calibrations #1 and #2

Experiment number	Date started	Duration (h)	Experiment duration (min)	Procedure description
5a	July 26	42	2520	Power and cooling on
5b	July 28	31	4380	
6a	July 29	48	2880	Water cooling off
6b	July 31	24	4320	Power and cooling off
6c	August 1	23	5700	Oxygen flow off, mercury thermometer installed
Cal 1W1	August 4	40	2400	Cooling and power on
Cal 1W2a	August 6	29	1740	Power on, cooling off
Cal 1W2b	August 7	41	4200	Power and cooling off

Table 3b - Test results for Experiments #5 and #6

Experiment #	5a		5b		6a		6b		6c	
Date	7/26	7/28	7/28	7/29	7/29	7/31	7/31	8/1	8/1	8/2
Time	1405	0805	0805	1447	1605	1603	1608	1606	1606	1525
Voltage (V)	2.29	2.34	2.34	2.34	2.34	2.34	0	0	0	0
Current (A)	0.706	0.376	0.376	0.329	0.329	0.329	0	0	0	0
Power (W)	1.62	0.88	0.88	0.77	0.77	0.77	0	0	0	0
T_{dewar} (°C)	35.54	36.53	36.53	36.68	36.78	37.29	37.29	36.86	36.86	36.92
ΔT_{dewar} (°C)		0.99		0.15		0.51		-0.43		0.06
$T_{ambient}$ (°C)	35.76	35.77	35.77	35.78	35.37	35.12	35.13	35.27	35.27	35.17
$T_{controller}$ (°C)	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
$T_{mercury}$ (°C)								36.9	36.9	36.9
$E_{e,in}$ (W·h)	0.14	50.56	0	23.69	0.06	37.06	0	0	0	0
E_{cool} (W·h)	0.13	54.28	0	23.34	0	0	0	0	0	0
$E_{cool} - E_{e,in}$ (W·h)		3.73		-0.35		-37.0		0		0

Table 3b - Test results for Calibrations #1 and #2

Experiment #	Cal 1W1		Cal 1W2a		Cal 1W2b	
Date	8/4	8/6	8/6	8/7	8/7	8/9
Time	1601	0800	0903	1403	1459	0759
Voltage (V)	0.996	0.996	0.998	0.991	0	0
Current (A)	0.988	0.988	0.988	0.988	0	0
Power (W)	0.98	0.98	0.99	0.98	0	0
T_{dewar} (°C)	35.07	35.46	35.65	37.09	37.08	36.84
ΔT_{dewar} (°C)		0.39		1.44		-0.24
$T_{ambient}$ (°C)	35.23	35.20	35.18	34.87	34.88	35.01
$T_{controller}$ (°C)	36.0	36.0	36.0	36.0	36.0	36.0
$T_{mercury}$ (°C)	36.9	36.9	36.9	36.7	36.7	36.9
$E_{e,in}$ (W·h)	0.1	39.44	0.08	29.39	0	0
E_{cool} (W·h)	0.1	40.88	0	0	0	0
$E_{cool}-E_{e,in}$ (W·h)		1.44		-29.4		0

During experiment #5a the cell resistance was increasing, so that the input current decreased from 0.71 A to 0.38 A (power went from 1.62 W to 0.88 W). The power was constant through most of experiment #5b and all through experiment #6a. At the beginning of experiment #6c a mercury thermometer was placed in the enclosure on top of the dewar in order to check the enclosure ambient temperature. From this time until the end of the calibrations the temperature indicated by this thermometer was 36.8±0.1°C.

Following the method used for experiments #1 to #3, the results for experiments #4 to #6 are given in Table 4.

Table 4 - Data from Experiments #4, #5 and #6

Expt. #	Electrical Energy In $E_{e,in}$ (W·h)	Thermal Energy Out E_{cool} (W·h)	Electrolysis Energy E_{elec} (W·h)	Measured Gas Released (L)	Theoretical Gas Production (L)	Calculated Recombination Energy E_{rec} (W·h)
4	142.7	65.4	87.1	21.8	36.8	35.3
5	74.0	77.4	47.2	-	-	47.2
6	36.7	0	23.2	-	-	23.2

(Note that in experiment #6 no heat was possible because the heat exchanger had been turned off. The cell temperature increased 0.51°C)

After studying the results of the last two experiments and the calibration runs, two new terms in the overall energy balance were introduced. The first term (E_{loss}) allowed for the energy that would leak through the dewar walls and lid due to the small difference between the temperature inside and outside the dewar. The second term (E_{cap}) was to account for the storage of heat in the dewar contents (heat transfer fluid and the complete cell), given the difference in temperature in the dewar between the start and end of a run. The terms can be defined:

$$P_{loss} = U(T_{dewar} - T_{ambient})$$

$$E_{cap} = C_{p,dewar}(T_{end} - T_{start})$$

where:

U = overall heat transfer coefficient of the dewar ($W \cdot K^{-1}$)

$C_{p,dewar}$ = specific heat of the dewar contents ($W \cdot h \cdot K^{-1}$)

The total energy output is thus given by:

$$E_{tot,out} = E_{cool} + E_{elec} + E_{loss} + E_{cap}$$

The value of $C_{p,dewar}$ was estimated to be at least 17.4 $W \cdot h \cdot K^{-1}$, based on the fact that the dewar had a volume of about 15 L, which, if filled only with water, would give this heat capacity. Given the different materials in the cell and the inner walls of the dewar, a best estimate of the heat capacity of the dewar contents was put at about 20 $W \cdot h \cdot K^{-1}$. The heat transfer coefficient was estimated from literature data for typical vacuum insulated containers to be between 0.05 and 0.1 $W \cdot K^{-1}$, although this was expected to be on the low side, because the lid was not tightly sealed.

A number of calibration runs were done to try to determine the values of these two parameters. A number of cooling curves were obtained and from these, coupled with all the other evidence, it was clear that the estimate of the dewar heat capacity was reasonable. However, the heat transfer coefficient was obviously incorrect.

During the calibrations, a check was made of the precision and accuracy of the thermocouples. These were found to be very good, giving temperatures within about ±0.1 K. However, the ambient temperature was determined at the board used for the thermocouple junctions, and during the calibrations this was found to be low by anything up to 2 K. The temperature reading of the enclosure controller was found to be approximately 0.8 K below the actual ambient temperature measured by a calibrated mercury-in-glass thermometer placed close to the lid of the dewar, and this value did not vary by more than 0.2 K over the course of the calibration runs (about five days).

A preliminary analysis of the results for experiment #5a was made with the aid of the results of calibration Cal 1W1, since the two runs had approximately the same duration. During this calibration run, the dewar temperature rose by 0.39 K. Given that there was no electrolysis and the output energy must be equal to the input energy, an energy balance for this situation is thus:

$$\begin{aligned}
E_{loss} &= E_{e,in} - E_{cool} - E_{cap} \\
&= 39.44 - 40.88 - 20 \times 0.39 \ W \cdot h \\
&= -9.24 \ W \cdot h
\end{aligned}$$

Given that in experiment #5a the measured dewar temperature was always above the dewar temperature in calibration Cal 1W1, the value -9.24 $W \cdot h$ represents a conservative estimate of the energy loss for experiment #5a as long as the ambient temperature was the same for both runs. In this case the energy balance can be calculated:

$$\begin{aligned}
E_{tot,out} &= E_{cool} + E_{elec} + E_{loss} + E_{cap} \\
&= 54.15 + 0.0 - 9.24 + 20 \times 0.99 \ W \cdot h
\end{aligned}$$

$$\begin{aligned}
E_{tot,in} &= E_{e,in} + E_{rec} \\
&= 50.56 + 0.0 \ W \cdot h
\end{aligned}$$

$$\begin{aligned}
E_{ex} &= E_{tot,out} - E_{tot,in} \\
&= 54.15 - 9.24 + 20 \times 0.99 - 50.56 \ W \cdot h \\
&= 14.15 \ W \cdot h
\end{aligned}$$

This excess heat of about 14 $W \cdot h$ is equivalent to 28% of the input energy.

Mathematical Modeling

The above method of analysis includes the assumptions that the ambient temperature and the heat transfer coefficient remained the same through the series of experiments and calibrations. Useful information may be gained by studying the temperature of the system as the power input and cooling were changed. A more powerful means of analyzing the data was to model the system using all the major energy terms (neglecting frictional energy, stirring energy, evaporative enthalpy and lead-wire resistance) as a function of time. The model thus estimated the temperature of the dewar contents as a function of time with the fitted parameters U, $C_{p,dewar}$, T_{start} and $\Delta T_{a,e}$ or $T_{a,e}$. The fitting was done using a least-squares method comparing the measured dewar temperature with the calculated dewar temperature The following assumptions were made:

- U is independent of temperature
- $C_{p,dewar}$, is 20 $W \cdot h \cdot K^{-1}$, and

either:
- The ambient temperature recorded at the junction board ($T_{ambient}$) was in error by the constant amount $\Delta T_{a,e}$. The effective ambient temperature ($T_{a,e}$) is thus $T_{ambient} + \Delta T_{a,e}$,

or:
- The ambient temperature was constant and equal to $T_{a,e}$.

The two models represent some conjectures as to what was most strongly influencing the heat loss from the dewar. The constant ambient temperature model goes on the assumption that the enclosure temperature controller was doing its job. The constant error in ambient temperature model assumes that the ambient temperature measurement was still following the enclosure temperature, but was being influenced by some heat source such as the nearby enclosure wall or radiant heat from the enclosure heaters.

Put in its differential form, the model is:

$$T_{dewar,2} = T_{dewar,1} + \frac{\int_{t_1}^{t_2} P_{e,in} \, dt + \int_{t_1}^{t_2} P_{rec} \, dt + \int_{t_1}^{t_2} -P_{cool} \, dt + \int_{t_1}^{t_2} -P_{elec} \, dt + \int_{t_1}^{t_2} -U(T_{dewar} - T_{a,e}) \, dt}{C_{p,dewar}}$$

Since the model was integrated numerically, it was first converted to the following difference form:

$$T_{dewar,t+\Delta t} = T_{dewar,t} + \frac{P_{e,in}\Delta t + P_{rec}\Delta t - P_{cool}\Delta t - P_{elec}\Delta t - U(T_{dewar} - T_{a,e})\Delta t}{C_{p,dewar}}$$

and the integration was done using rectangular integration, because the time intervals were so short relative to the rate of change of the measured variables.

The advantage of this model becomes clear after looking at the form of the last equation and noting that the only term that depends on temperature is the heat transfer term (E_{loss}). The significance of this is that the heat transfer term is the only one which will produce a curve in the dewar temperature/time function. Thus, in all the runs (both experiments and calibrations) where there is significant curvature in the dewar temperature, the heat transfer coefficient U can be estimated from the shape of the curve independently of other effects. This, of course, presumes that the excess heat predicted by Mills is not a significant function of temperature (over, at most, 3 K). Note also, however, that the actual estimate of U is somewhat influenced by the estimate of the ambient temperature.

The model can be judged first on how well the modeled dewar temperature matched the measured dewar temperature over the course of a run, and then (most importantly) on whether the parameters

were consistent from run to run and consistent with the estimates. Table 5 summarizes the results of the modeling of the calibration runs (including an earlier, higher-power run) and reports the fitted values of heat transfer coefficient and effective ambient temperature or error in ambient temperature. The term called Standard Error is the square root of the sum of the squares of the differences between the modeled dewar temperature and the measured dewar temperature divided by the number of time intervals in the run. The term E_{net} is defined in the same way as E_{ex} $(= E_{tot,out} - E_{tot,in})$.

Table 5a - Model Fitting Results for Constant Error in Ambient Temperature

Run	Time (h)	Energy in (W·h)	$\Delta T_{a,e}$ (K)	U (W·K^{-1})	E_{loss} (W·h)	Standard Error (K)	E_{net} (W·h)
Cal 1W1	40.4	39.8	0.28	1.60	-9.35	0.060	-0.43
Cal 1W2	71.5	28.9	1.80	1.65	4.82	0.071	-1.30
Cal 15W	26.2	382.0	0.55	1.46	7.29	0.068	-1.54

Table 5b - Model Fitting Results for Constant Ambient Temperature

Run	Time (h)	Energy in (W·h)	$T_{a,e}$ (°C)	U (W·K^{-1})	E_{loss} (W·h)	Standard Error (K)	E_{net} (W·h)
Cal 1W1	40.4	39.8	35.49	1.82	-9.75	0.060	-0.84
Cal 1W2	71.5	28.9	36.72	1.37	7.73	0.095	1.61
Cal 15W	26.2	382.0	38.08	1.51	-25.92	0.140	-8.78

The figures given in the Appendix (Figures A1 to A6) present the results of the modeling for the calibration runs, showing the match between measured and calculated dewar temperature. From the standard errors in Tables 5a and 5b and from Figures A1 to A6, it is clear that the constant error in ambient temperature model is much more consistent with the experimental results. This model was therefore selected to perform the analysis of the experiments. Another reasonable assumption is that the heat transfer coefficient is constant. While some reservations might be held about the possible variation in U because of the way the top of the dewar may be placed from run to run, with such high values of U as are given in Tables 5a and 5b, it is expected that the dewar must have lost its vacuum and therefore the dewar walls must be the main area of heat loss compared with the 50 mm thick polystyrene top. The best value to assume for U would appear to be 1.46 W·K^{-1} since this was calculated for the higher power run where errors are expected to be less.

A slightly troubling result of the modeling is the low ambient temperature during calibration run Cal 1W1. If we believe the temperature shown by the mercury thermometer represents the true effective ambient temperature, then $T_{a,e}$ is low by at least 1.2°C. If, conversely, the ambient temperature is fixed at 36.7°C, then the best fit for the heat transfer coefficient is found to be 0.15 W·K^{-1} and the standard error is 0.075 K. For comparison, Figure A2a shows the result of this set of parameters. Clearly, the fit is poor and the value of the heat transfer coefficient is too low to be credible.

In order to look at the experiments, two approaches could be taken. The first is to repeat the modeling following the method used for the calibration runs and look at the parameters which are fitted to see if they are reasonable. The second approach might be to modify the model slightly to allow for another parameter, namely E_{ex} with the simple assumption that P_{ex} would be constant over an experiment The modification would be simply:

$$T_{dewar,2} = T_{dewar,1} + \frac{\int_{t_1}^{t_2} P_{e,in}\,dt + \int_{t_1}^{t_2} P_{rec}\,dt + \int_{t_1}^{t_2} -P_{cool}\,dt + \int_{t_1}^{t_2} -P_{elec}\,dt + \int_{t_1}^{t_2} -U(T_{dewar} - T_{a,e})\,dt + \int_{t_1}^{t_2} P_{ex}\,dt}{C_{p,dewar}}$$

and thus:

$$T_{dewar,t-\Delta t} = T_{dewar,t} + \frac{P_{e,in}\Delta t + P_{rec}\Delta t - P_{cool}\Delta t - P_{elec}\Delta t - U(T_{dewar} - T_{a,e})\Delta t + P_{ex}\Delta t}{C_{p,dewar}}$$

Using the first approach, we can assume that the ambient temperature error is constant over the entire experiment, i.e. it is not necessary to divide the experiments into #5a and #5b, or #6a, #6b and #6c. Table 6a presents the results of this model.

Table 6a · Model without P_{ex}

Run	Time (h)	Energy in (W·h)	$\Delta T_{a,e}$ (K)	U (W·K^{-1})	E_{loss} (W·h)	Standard Error (K)	E_{net} (W·h)
Expt #4	93.6	142.7	1.21	1.46	0.9	0.086	0.2
Expt #5	73.0	74.0	0.91	1.46	-28.0	0.064	-0.8
Expt #6	93.4	36.7	1.70	1.46	38.7	0.089	3.5

Table 6b gives the results of the model with P_{ex} included.

Table 6b · Models with P_{ex}

Run	Time (h)	Energy in (W·h)	$\Delta T_{a,e}$ (K)	U (W·K^{-1})	E_{loss} (W·h)	Standard Error (K)	E_{ex} (W·h)	E_{net} (W·h)
Expt #4	93.6	142.7	1.07	1.46	20.0	0.086	19.2	0.2
Expt #5	73.0	74.0	0.82	1.46	-18.1	0.064	9.9	-0.8
Expt #6	93.4	36.7	1.65	1.46	44.8	0.078	6.0	3.5

In this model the excess energy term was found to be between 10% and 15% of the input energy. Figures are included in the Appendix showing the measured and predicted dewar temperature for all the above cases (Figures A7 to A12). There is clearly a better fit for experiment #6 when the excess heat term is included.

Table 7 summarizes the results of the energy balances, showing that E_{net} is within ±5% of the input electrical energy, except for run #6. The difficulty however, lies in deciding whether the model parameters are reasonable and whether there is any way to choose between the two models.

Table 7 · Overall Energy Balance Terms

Run	-$E_{e,in}$ (W·h)	-E_{rec} (W·h)	E_{cool} (W·h)	E_{elec} (W·h)	E_{loss} (W·h)	E_{cap} (W·h)	E_{ex} (W·h)	E_{net} (W·h)
Expt #4	-142.7	-35.3	65.4	87.1	0.9	24.9	-	-0.4
Expt #5	-74.0	-47.2	77.4	47.2	-28.0	23.8	-	-0.7
Expt #6	-36.7	-23.2	0	23.2	38.7	1.4	-	3.2
Expt #4	-142.7	-35.3	65.4	87.1	20.0	24.9	19.2	-0.4
Expt #5	-74.0	-47.2	77.4	47.2	-18.1	23.8	9.9	-0.7
Expt #6	-36.7	-23.2	0	23.2	44.8	1.4	6.0	3.2

4.   DISCUSSION

In the higher power experiments (#1, #2 and #3), no net excess or deficit energy was observed greater than experimental error. According to Mills, this result was consistent with operation at currents and voltages substantially higher than 1 mA·cm^{-2} and 2.5 V. The lower power experiments were done within the recommended current density and voltage, and according to Mills the expected excess heat would be about 0.25 W. Various methods of analysis were applied to the results of experiments #4, #5 and #6. Some of these analyses indicated possible excess heat at approximately this level.

In experiments #4, #5 and #6, an effort was made to model the results in a consistent manner to account for the observations. The parameters that were used in the models were chosen because they were either unknown or appeared to be measured incorrectly. However, they were not expected to vary widely or completely randomly. In all models the ambient temperature correction was not very consistent. This variation may well be related to the total heat load on the system enclosure temperature control system. The effective ambient temperature was not consistent either (and the corresponding model was consequently not used to analyze the experiments), even though the temperature controller for the enclosure was absolutely steady (apparently), as was the thermometer that was placed in the enclosure during experiment #6c (at least within 0.2 K).

It seemed reasonable to assume a constant value of U from the results of the higher power calibration and use this for all analyses. However, this would only be valid if the heat transfer is just through the dewar walls. If significant heat transfer occurs through the lid, the value of U would change each time the lid was removed and replaced.

It is instructive and revealing to consider the sensitivity of the results to the different parameters used in the modeling. The most critical is the ambient temperature estimate. If we take an average heat transfer coefficient of say 1.5 W·K^{-1} and an average experiment duration of 60 hours, then a 0.1 K error in the ambient temperature corresponds to an error of 9 W·h in the heat loss term, which is approximately equal to the magnitude of the expected excess heat. It is unlikely that any of our temperature measurement were within this level of accuracy and it was unfortunate that the dewar had such poor insulating properties.

In fact the above calculation for the sensitivity of the heat loss to the ambient temperature also applies to the temperature inside the dewar. It is very likely that in the unstirred dewar, there would have been significant temperature gradients, especially top-to-bottom. It would be reasonable to assume that such temperature gradients in the dewar during calibration runs would be quite different from the gradients during closed cell operation with the recombiner. More than half the heat in experiments #5 and #6 was released to the dewar contents in the top of the cell where the recombiner was placed. In other cases, calibrations or open cell operation, all or most of the heat is released through the electrolyte in the lower part of the cell. There is no obvious way to deduce the magnitude of the temperature gradients from the results presented here.

Both the temperature inside the dewar and the ambient temperature were point measurements. Total heat loss from the dewar depends on the heat lost from all parts of the dewar surface and therefore is affected by the any temperature profiles either inside or outside. Point measurements can, at best, only be an indication of the average temperature. The modeling is an attempt, with only limited success, at finding an *effective* ambient temperature which is consistent with the measured temperature-time function in the dewar. Stirring the dewar contents, circulating the ambient air and using non-radiant heat in the enclosure would have significantly improved the representativeness of the point temperature measurements.

In experiment #4 an open cell was used and the off gases vented through a mass-flow transducer. With the low-voltage experiments the off-gases were typically evolved at a rate of 3 mL·min^{-1} (compared to a flow rate of 26 mL·min^{-1} in the higher voltage experiments). At low flow rates, the absolute accuracy of the mass-flow transducer used was a source of some concern, but from the data we have there would appear to be a higher recombination rate in experiment #4 than in experiments #1 and #2. This fits with the expected mechanism for recombination, which is the reaction between each of the gases with nascent gas bubbles at the opposite electrode — especially at the anode, which was made of the highly catalytically active material, platinum. Recombination is strongly promoted by stirring the electrolyte, as was done in these experiments. If, however, it is assumed that none of

the electrolysis gases recombine, the energy balance for this experiment (see Table 7) seems to indicate that up to 54.5 W·h of excess heat was produced (35.3 W·h + 19.2 W·h). This figure corresponds to 38% of the electrical input energy and agrees with the amount predicted by Mills.

A major part of this work was the development of a model to simulate the heat transfer characteristics of the calorimeter. The model, which includes the thermal capacity of the dewar contents and the heat exchange through the dewar walls and top, was reasonably successful in closing the energy balance except for experiment #6. Assuming a constant ambient temperature of 36.70°C, the results of experiment #6 would indicate about 14 Wh of excess heat produced. This figure corresponds to 38% of the electrical input energy. This result agrees with the amount predicted by Mills.

Experiments #4, #5 and #6 stretched the capabilities of the experimental system to the limit. Any further work in this area would require more sensitive and accurate temperature-measuring devices, and a considerably more efficient dewar.

5.   REFERENCES

1.   P.L. Hagelstein, Summary of the Third International Conference on Cold Fusion, Presented at MIT, 1993 January 16.

2.   E. Storms, Fusion Technology, 20, 433 (1991).

3.   R.T. Bush, Fusion Technology, 22, 301 (1992).

4.   R. Notoya and M. Enyo, Proc. ICCF3, Dec (1992).

5.   R. Mills and S.P. Kneizys, Fusion Technology, 20, 65 (1991).

6.   R. L. Mills, W.R. Good and J.J. Farrell in Unification of Spacetime, the Forces, Matter and Energy, 1992, Science Press, Pa.

7.   W.A. Good, Personal Communication 1993, June 8.

8.   JANAF Thermochemical Tables, Third Edition, 14, (1), 1274 (1985)

9.   Handbook of Physics and Chemistry, 71 st Edition, CRC Press, 15-30 (1991)

10.   R.H. Perry and D.W. Green, Perry's Chemical Engineers' Handbook , 6th edition, McGraw-Hill, 1984.

Appendix
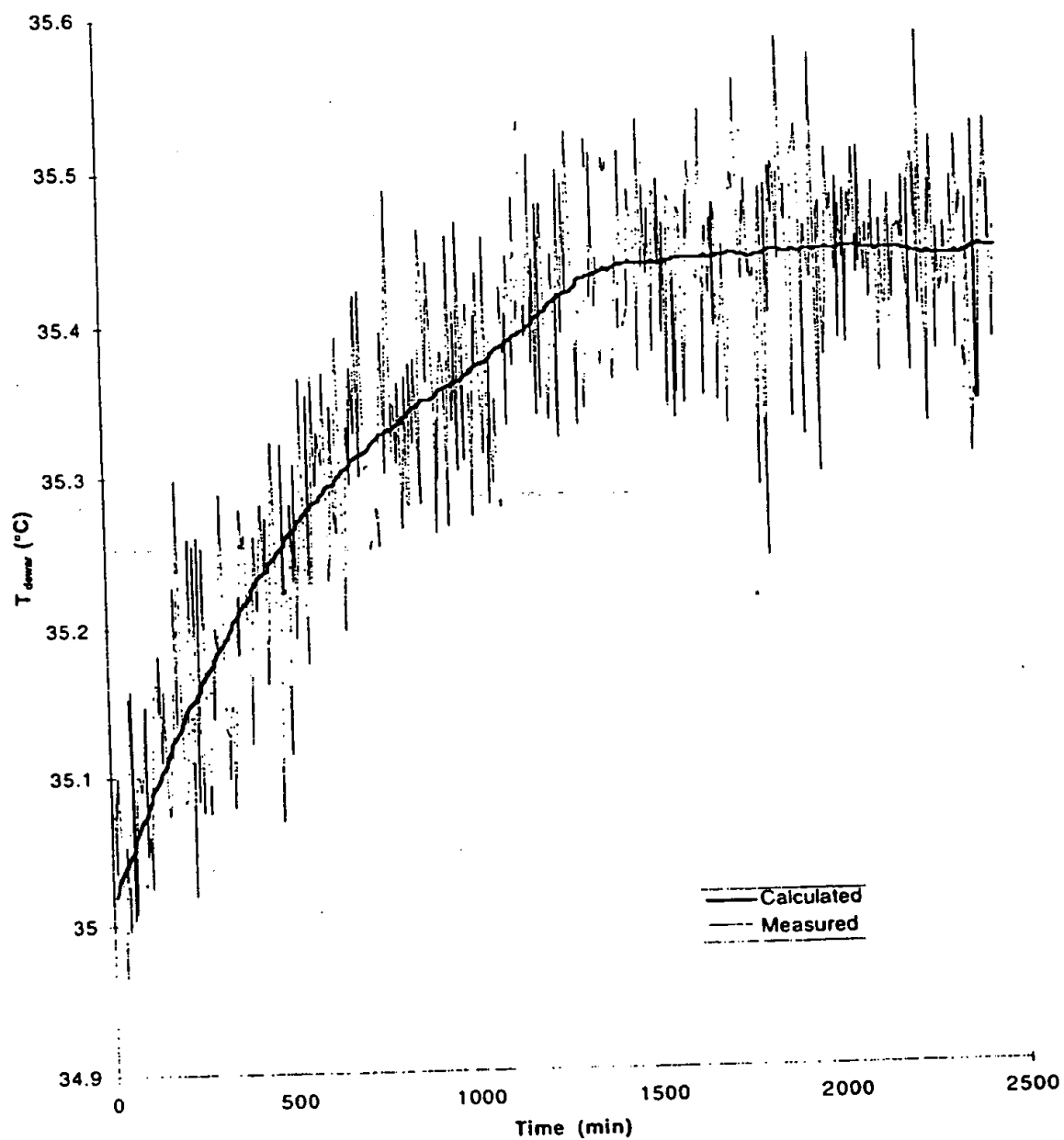
Figure A1 - Dewar Temperature Modelling in Calibration CallW1
using Constant Error in Ambient Temperature
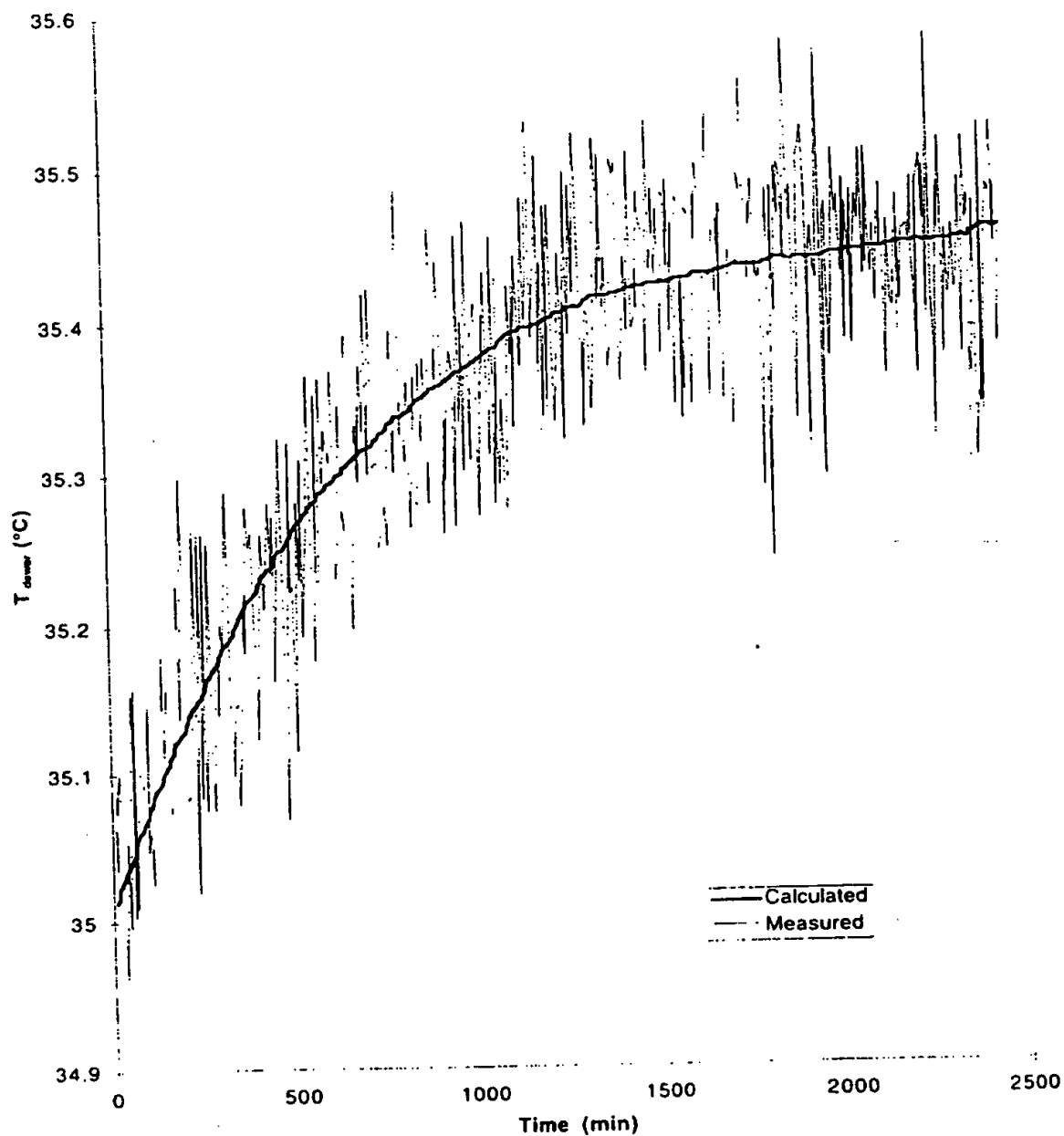
Figure A2 - Dewar Temperature Modelling in Calibration Cal1W1
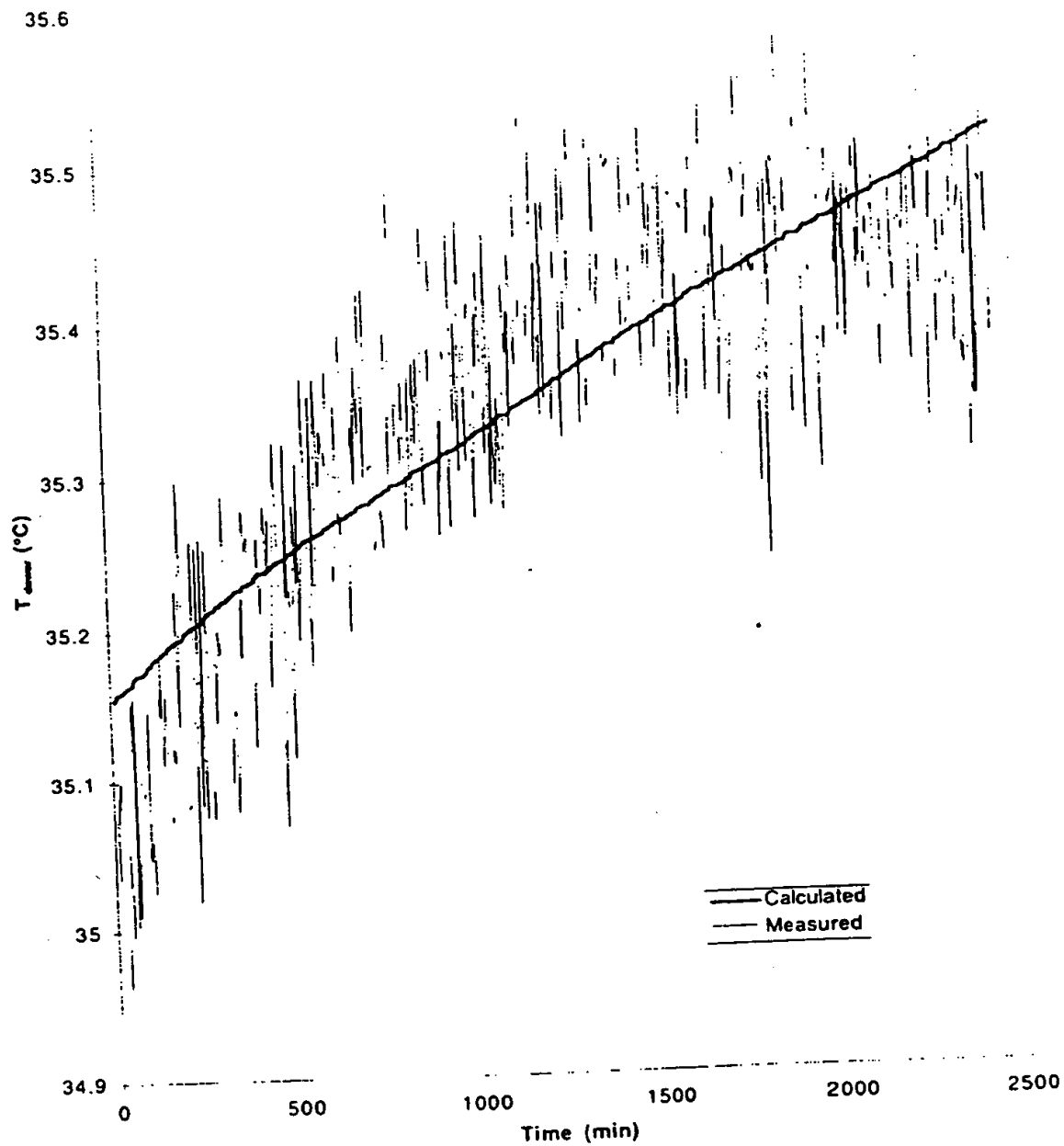using Constant Ambient Temperature

Figure A2a - Dewar Temperature Modelling in Calibration Cal1W1
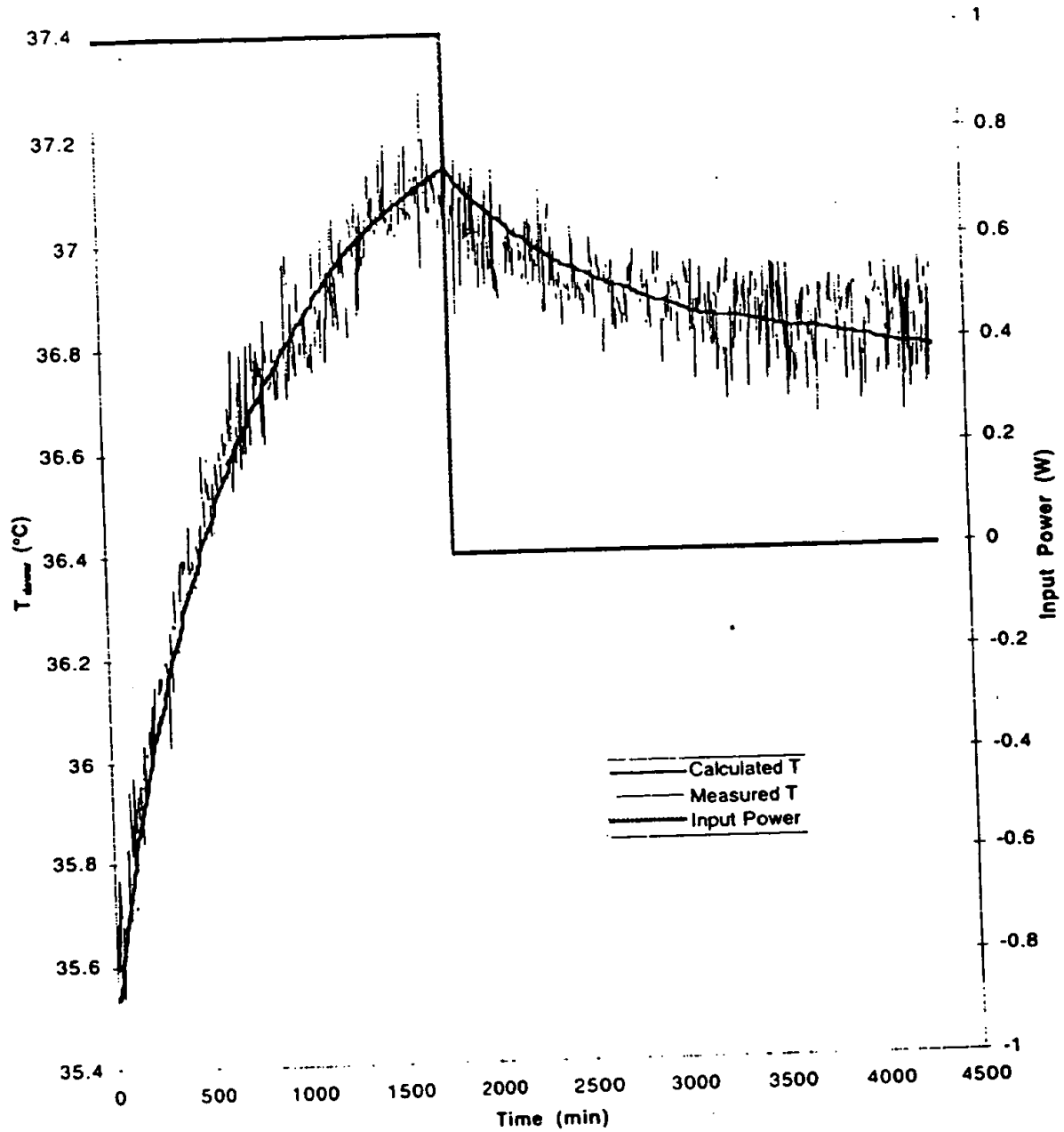using Ambient Temperature set to 36.7°C

Figure A3 - Dewar Temperature Modelling in Calibration Cal1W2
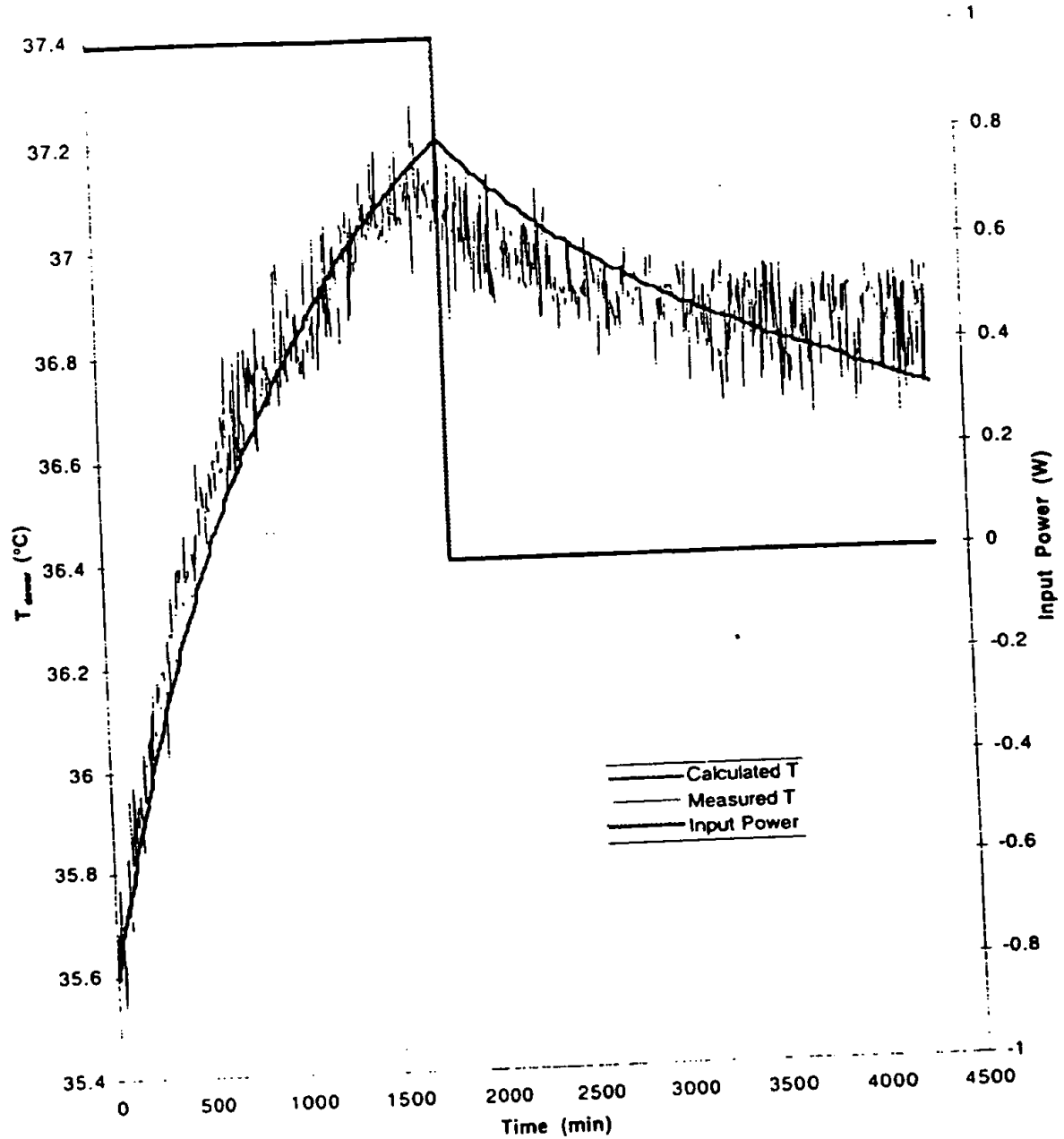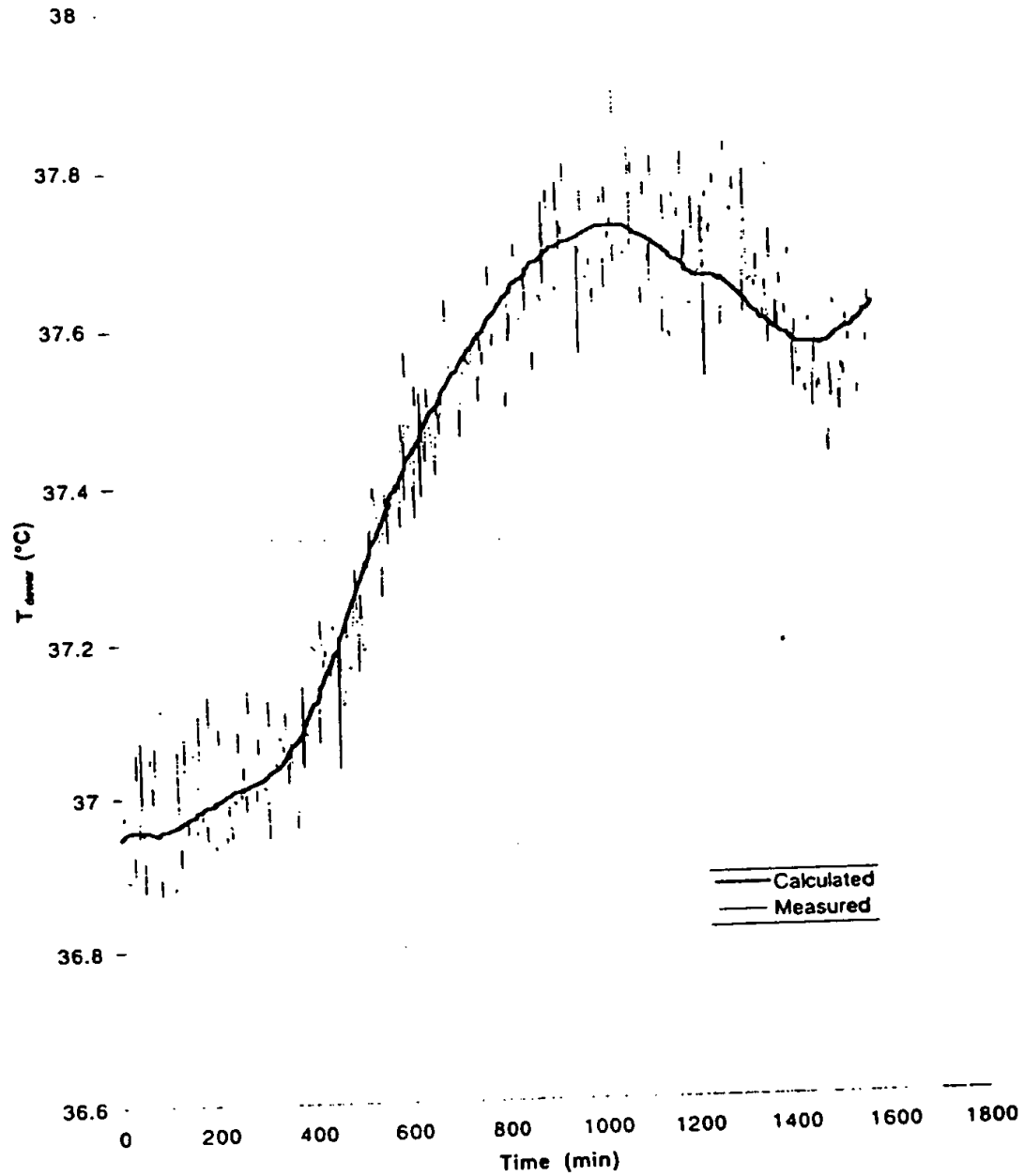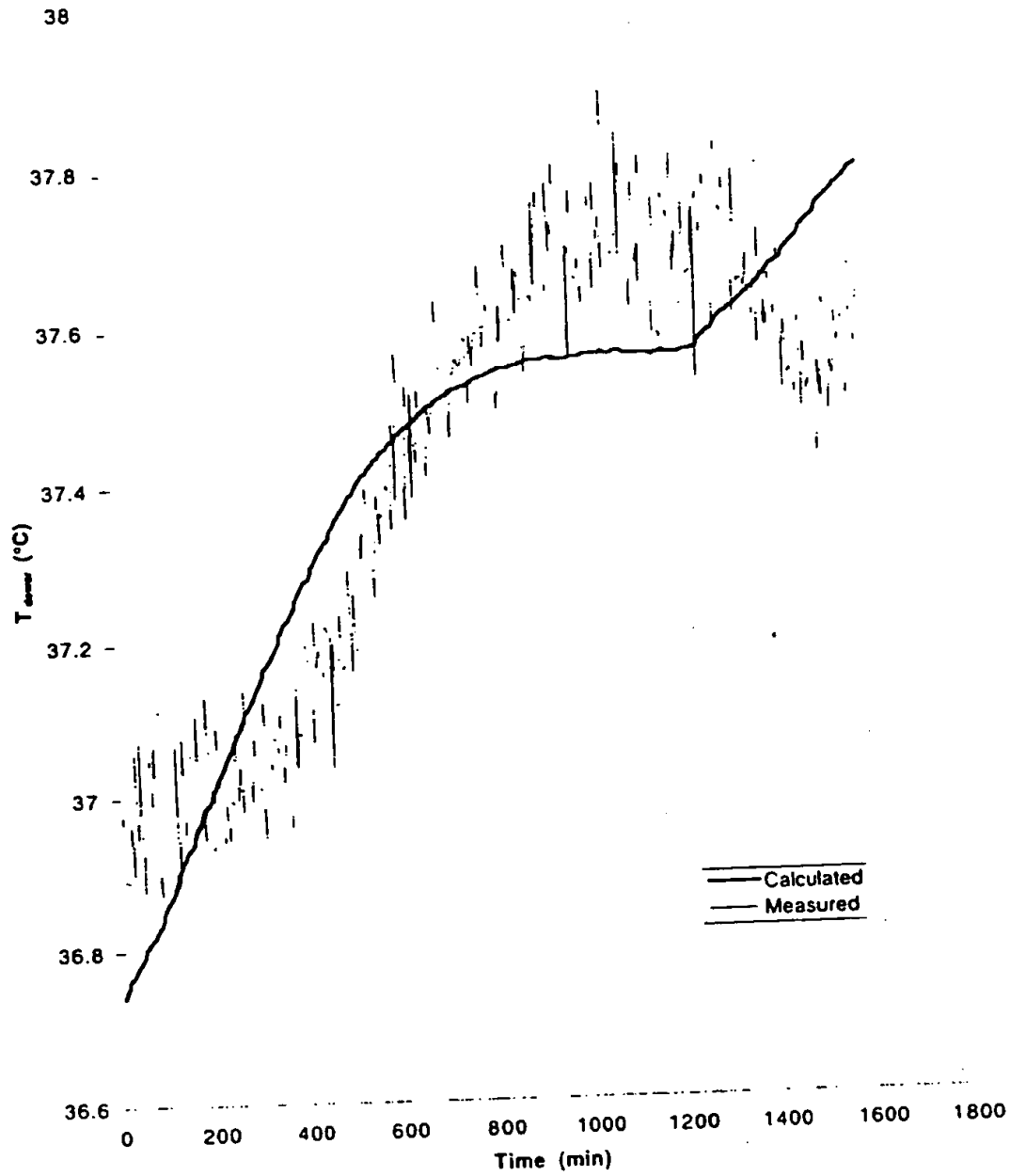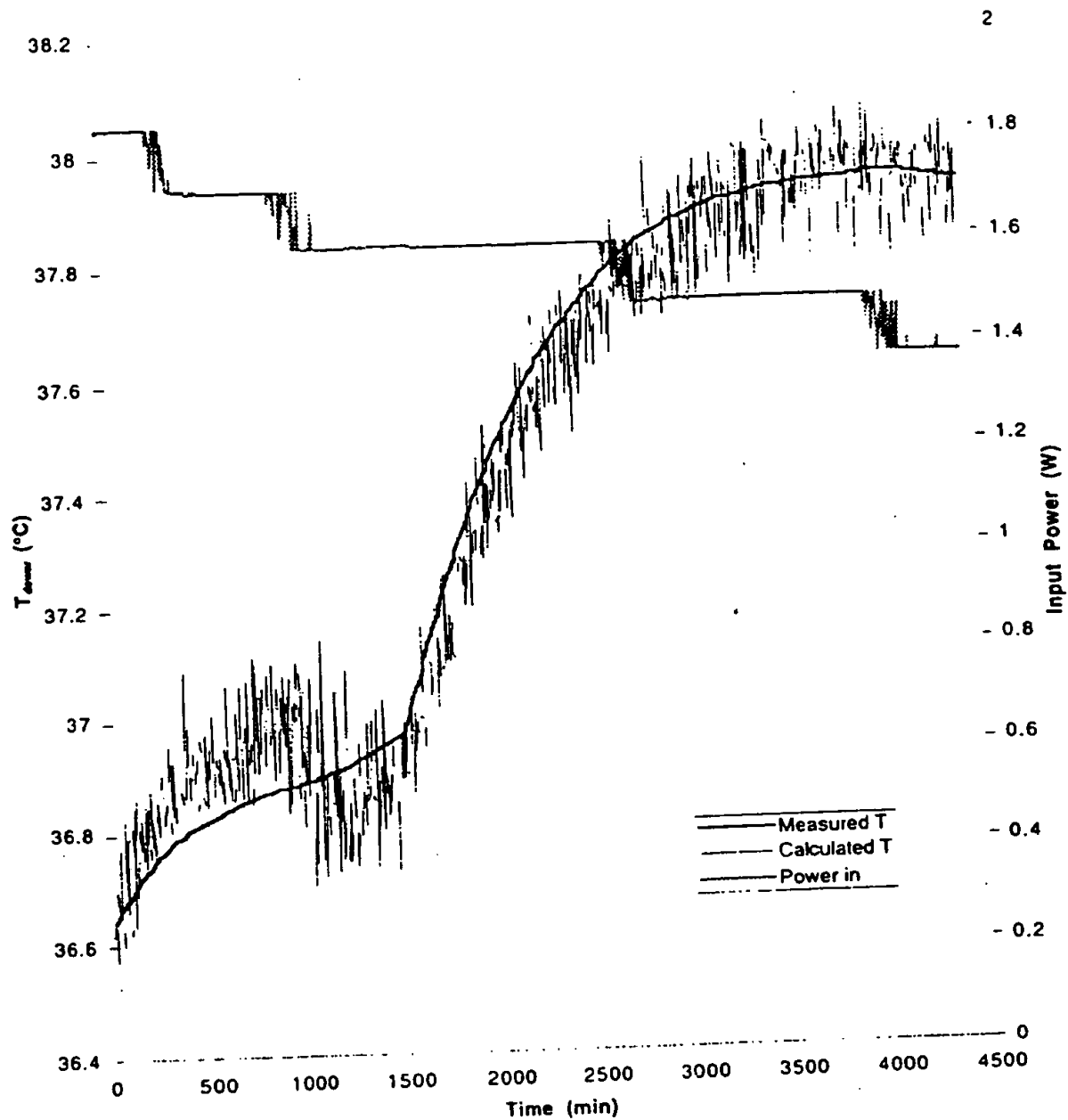using Constant Error in Ambient Temperature

Figure A4 - Dewar Temperature Modelling in Calibration Cal1W2
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Figure A5 - Dewar Temperature Modelling in Calibration Cal15W
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Figure A6 - Dewar Temperature Modelling in Calibration Cal15W
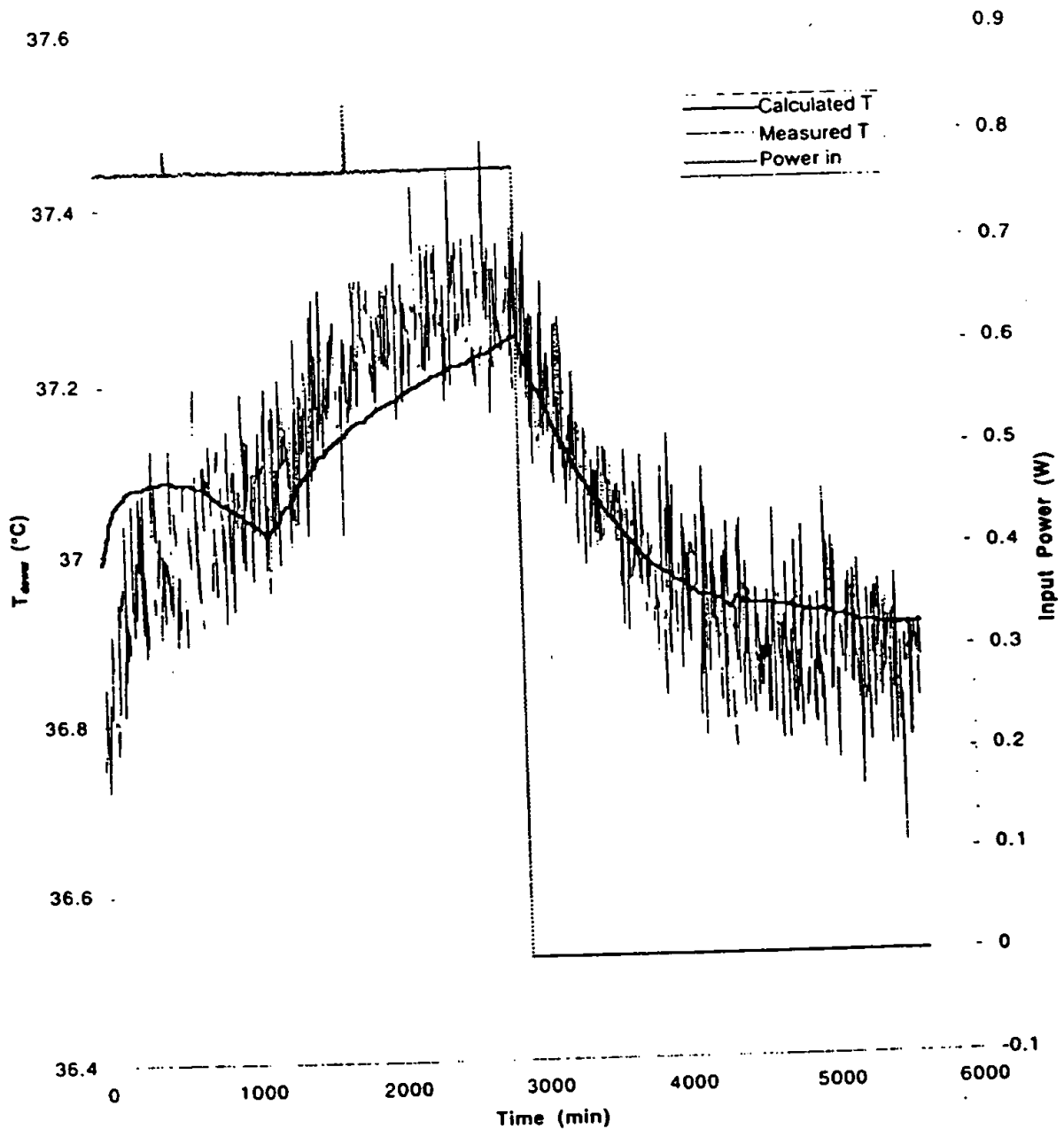using Constant Ambient Temperature

Figure A7 - Dewar Temperature Modelling in Experiment #4 using Constant Error in Ambient Temperature and $P_{ex}=0$
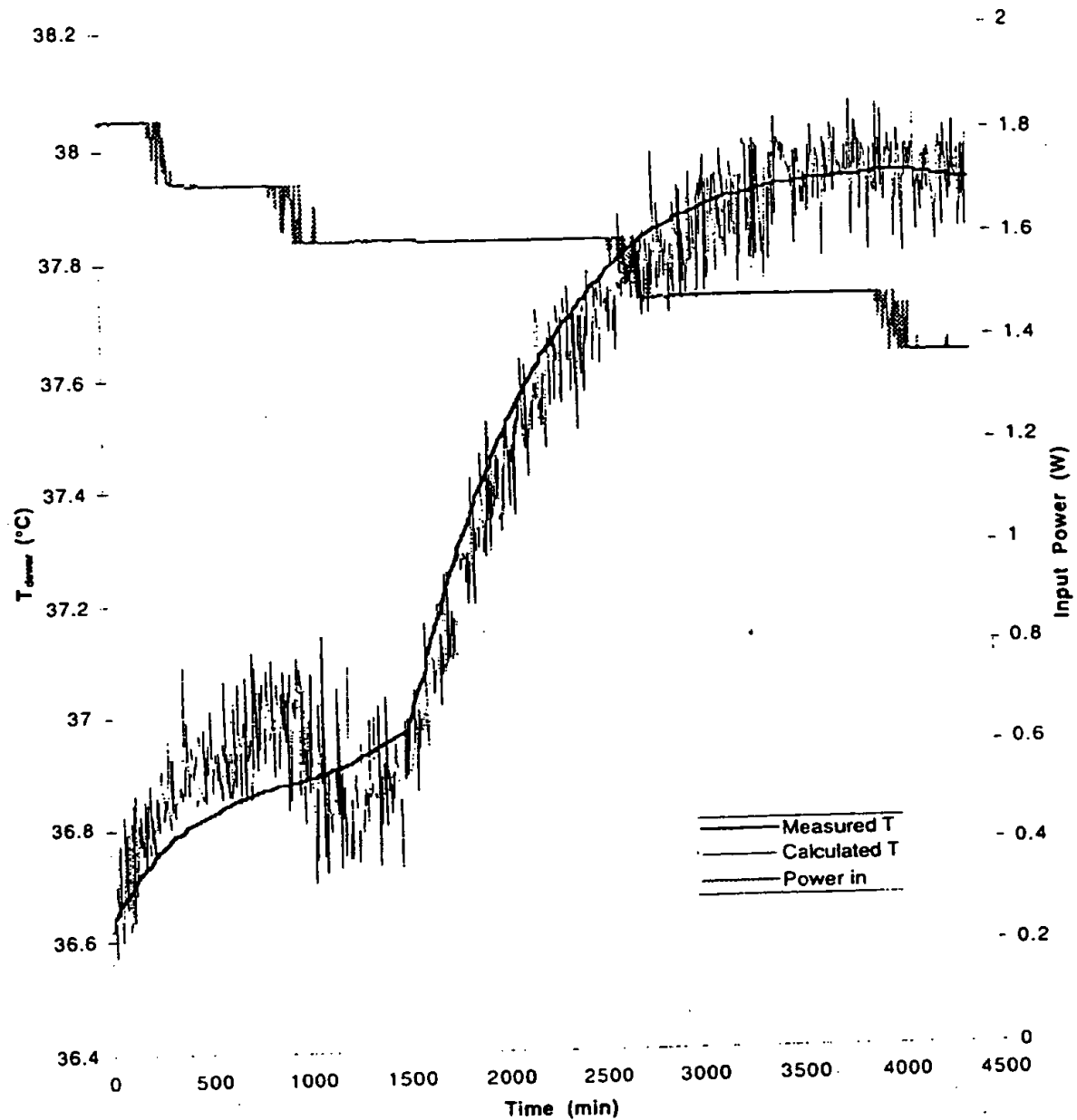
Figure A8 - Dewar Temperature Modelling in Experiment #4
using Constant Error in Ambient Temperature and $P_{ex}=0$
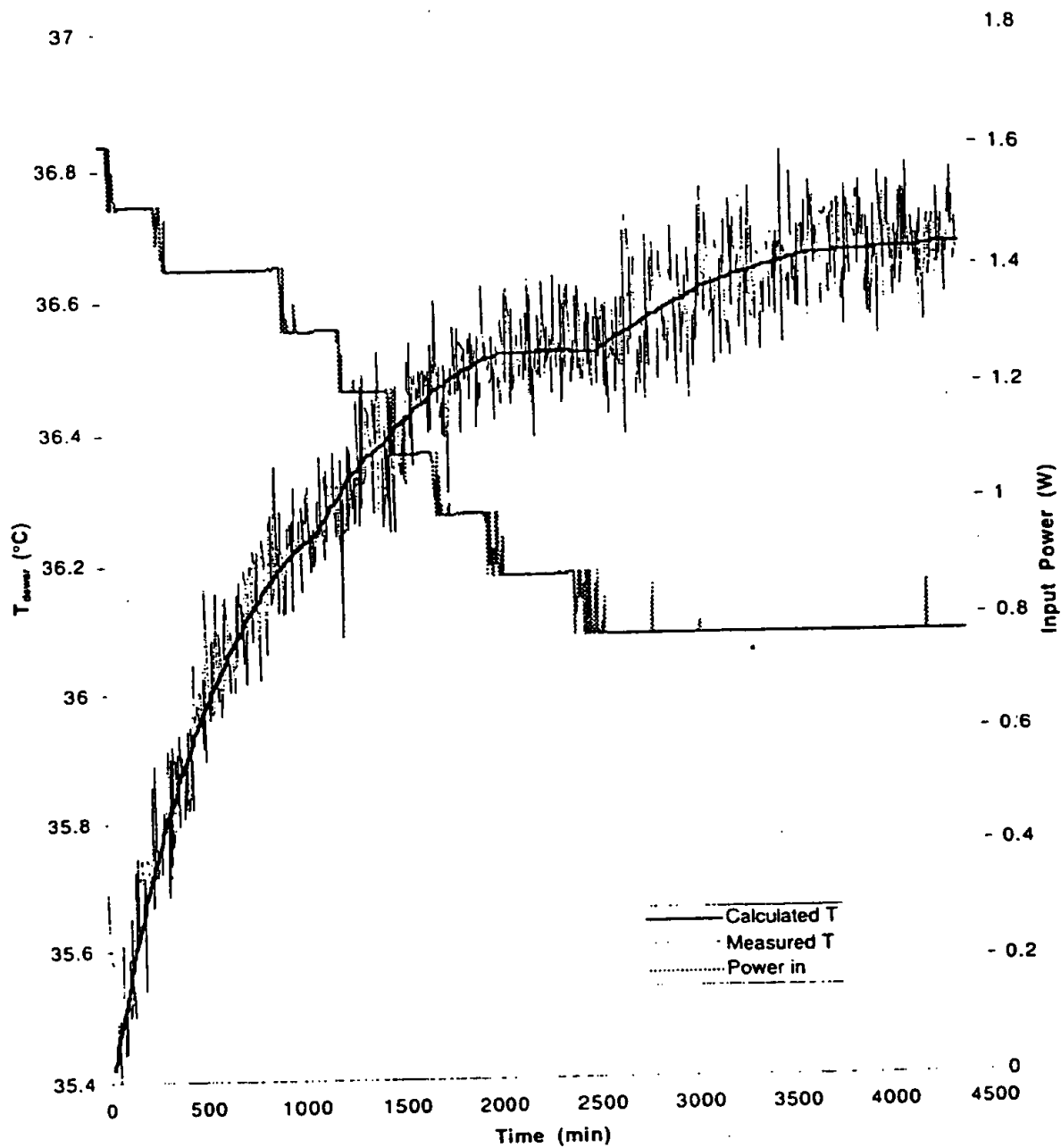
Figure A9 - Dewar Temperature Modelling in Experiment #5
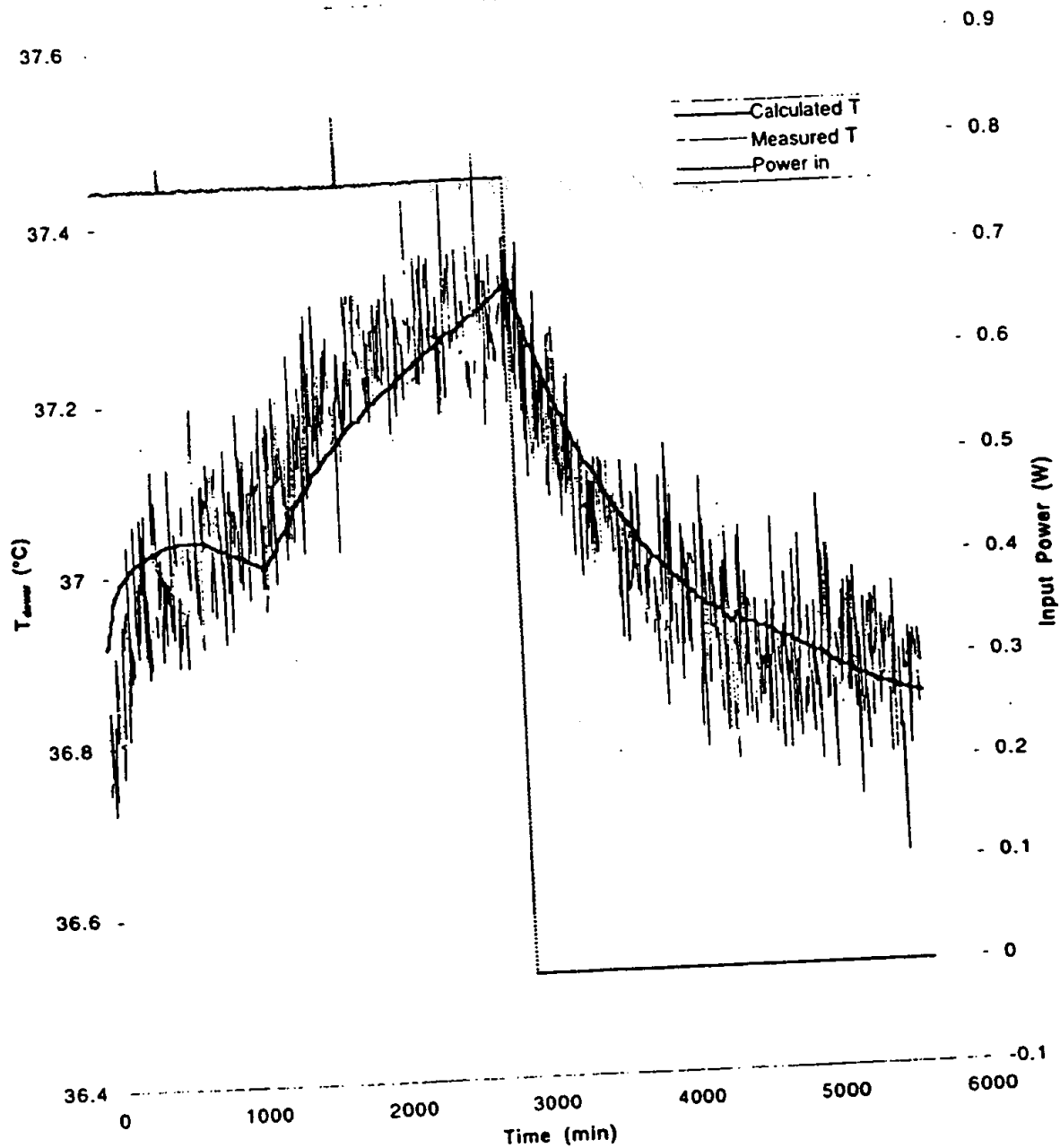using Constant Error in Ambient Temperature and $P_{ex}=0$
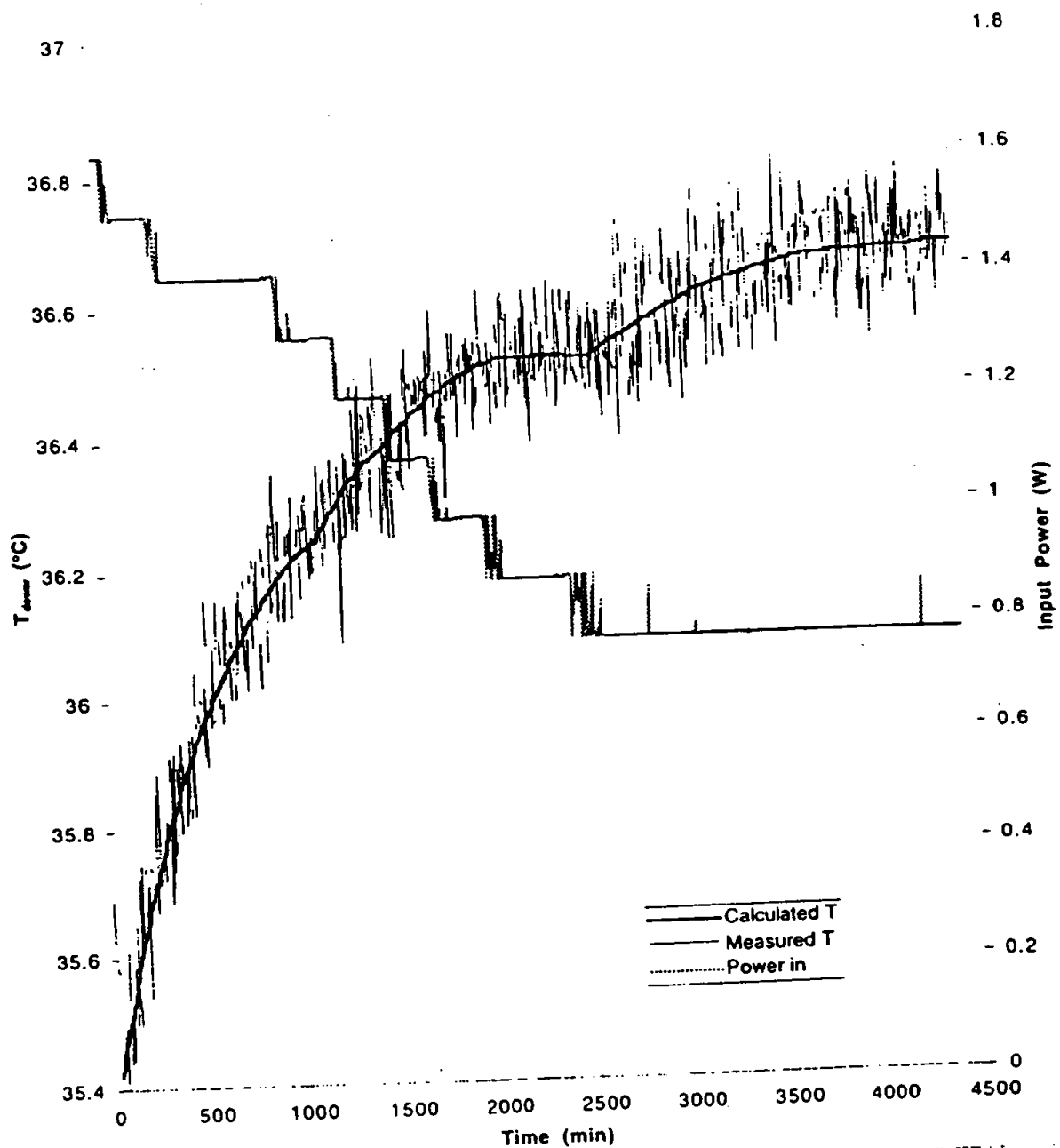
Figure A10 - Dewar Temperature Modelling in Experiment #5
using Constant Error in Ambient Temperature and $P_{ex} \neq 0$

Figure A11 - Dewar Temperature Modelling in Experiment #6
using Constant Error in Ambient Temperature and $P_{ex}=0$

Figure A12 - Dewar Temperature Modelling in Experiment #6
using Constant Error in Ambient Temperature and $P_{ex} \neq 0$

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ANOMALOUS HEAT FROM ATOMIC HYDROGEN IN CONTACT WITH POTASSIUM CARBONATE

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7 PAGES

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ANOMALOUS HEAT FROM ATOMIC HYDROGEN IN CONTACT WITH POTASSIUM CARBONATE

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Anomalous heat was observed when a nickel tube submerged in 0.6 molar K_2CO_3 was pressurized with hydrogen gas. Minimal heat was observed when 0.6 molar Na_2CO_3 was used. These results are consistent with a new atomic theory whereby atomic hydrogen can exist in fractional quantum energy levels--below the traditional ground state.

I. INTRODUCTION

Excess heat from electrolytic cells has been reported in a significant number of studies using a variety of procedures and calorimeter designs. These studies found, in most cases, many positive results using both light and heavy water.[1-6]

Light water electrolytic experiments conducted at Thermacore also show positive results. The most outstanding example is a cell producing 41 watts of heat with only 5 watts of electrical input power. This cell has operated continuously for over one year.[7]

There are many theories attempting to explain the physics and/or chemistry causing the excess heat. Some include a nuclear reaction; others chemical. The authors subscribe to the non-nuclear theories simply because our chemical, scintillation counter and photographic film measurements have not detected the presence of nuclear by-products above background. This is confirmed by most experimenters showing nuclear by-products orders of magnitude below those required to explain the excess energy.[9]

One theory that does not rely on nuclear reactions is proposed by Mills.[2] Mills claims that the atomic hydrogen produced by electrolysis at a nickel cathode reacts with a potassium carbonate catalyst to produce excess energy while making a new form of hydrogen as the "ash."

Thermacore has tested the Mills' theory by establishing the conditions for producing excess heat without using electrolysis. The nickel cathode of the Mills' electrolytic cell was replaced with a thin walled nickel tube containing high pressure hydrogen. The hydrogen molecules are dissociated into atomic hydrogen on the tube inside surface. The hydrogen permeates through the tube wall and contacts potassium carbonate on the outer wall. Energy is produced, and according to the Mills' theory a new form of hydrogen, without the need for electrolysis. The non-electrolytic test apparatus and results are described below.

II EXPERIMENTAL

A schematic of the non-electrolytic cell is shown in Figure 1. It consisted of 6.1 meters of annealed nickel tubing 0.160 centimeters outer diameter with a 0.025 centimeter wall. The tube was wrapped into a coil 4.3 centimeters long by 2.8 centimeters in diameter. One end of the tube was welded closed; the other end passed through the end cap of a cylindrical pressure vessel and connected to a Nupro SS4H isolation valve.

The cylindrical pressure vessel was annealed nickel 200 tubing 8.9 centimeters long by 3.5 centimeters outer diameter with a 0.160 centimeter thick wall. The end caps were machined from 0.318 centimeter thick nickel 200 plate and welded to the cylinder. The pressure vessel was protected by a 0.635 centimeter stainless steel pressure relief valve NUPRO R3A set at 133 atmospheres. A 0.635 centimeter NUPRO SS4H fill and vent valve was also attached to the upper end cap.

Temperatures were measured with an Omega 0.160 centimeter diameter type K, 316SS sheathed ungrounded thermocouple that passed through a Swagelock type 200R4B fitting welded to the bottom end cap. Temperatures were recorded using a microprocessor thermometer (Omega HH21) having a detection limit of $\pm 0.1°C$.

The internals of the pressure vessel were cleaned by filling it with 0.6 molar K_2CO_3/3% H_2O_2 for 30 minutes. The solution was removed, and the pressure vessel was rinsed in distilled water. A fluid charge of 30 ml of 0.6 molar K_2CO_3 was added to the cylinder covering the coiled nickel tubing. A 17 bar nitrogen cover gas was used to suppress boiling within the pressure vessel.

The heater consisted of a 14.4 ohm, 1000 watt Inconel 600 jacketed Nichrome heater made by Watlow. It was wrapped around the outside diameter of the cylindrical pressure vessel and powered by a 110 VAC variable transformer Powerstat 3PN116C. The voltage ($\pm 0.1\%$) and current ($\pm 0.1\%$) were recorded with a Fluke 8600A digital multimeter. The heating power was calculated from these measured values and remained constant throughout the test.

The entire pressure vessel, valves, fittings, and associated tubing were covered with one inch of Fiberfax insulation. The effectiveness of the insulation can be established by noting that 35 watts of heater power were required to increase the temperature of the pressure vessel to 215°C above the 18°C room temperature ambient.

The tubing was leak checked before and after the test using a helium mass spectrometer leak detector with a sensitivity of 10^{-10} std cc/sec. Helium pressure inside the tubing was set at 2000 psi while the pressure vessel space was evacuated after connecting to the mass spectrometer. No leaks were observed.

A duplicate set of the experimental apparatus was fabricated to serve as a control. It was cleaned and treated identically as the K_2CO_3 apparatus except the control used 0.6 molar Na_2CO_3 as a working fluid in place of the K_2CO_3. Chemical analysis of the working fluid was done to

identify any potassium contamination. Mills' theory[2] shows that unlike K_2CO_3, Na_2CO_3 does not provide the 27.2 eV energy sink required to stimulate hydrogen electron transitions to fractional quantum levels. The theory predicts that no excess heat should be produced using Na_2CO_3

III RESULTS

The calibration and test results are shown in Figures 2 and 3. The procedure included a calibration run with the I^2R heater energized and the hydrogen pressure set to zero. This calibration run was followed by pressurizing the nickel coil with hydrogen for about 5 hours then venting the hydrogen to atmosphere. The individual steps taken are listed below:

- The inside of the nickel tubing was opened to atmosphere through the isolation valve. This condition existed during the calibration run; calibration results are shown in Figure 3.

- The I^2R heater power was set at 35 watts which resulted in a steady state pressure vessel temperature of 215°C above ambient. The 215°C temperature rise was used to help provide adequate hydrogen permeation through the wall of the nickel tube. This condition was held for 20 hours to assure steady state conditions existed.

- The inside of the 0.160 centimeter diameter nickel tube was evacuated and immediately pressurized with 70 atmospheres of hydrogen gas.

- The pressure vessel temperature began to rise as shown in Figure 2.

- At 301°C rise above ambient, the hydrogen pressure inside the 0.160 centimeter diameter tubing was vented to 1 atmosphere air to stop the reaction and prevent the potassium carbonate saturation pressure from actuating the relief valve.

- The vessel temperature began to drop immediately after venting the hydrogen.

The data in Figure 2 show an increase in cell temperature of 86°C after the application of hydrogen pressure inside the nickel tubing. The equivalent power required to provide this temperature increase has been estimated from the slope of the calibration curve shown in Figure 3 to be about 50 ± 3 watts.

A nominally identical test was done using the control apparatus with Na_2CO_3 as the working fluid. The results from this experiment are also plotted in Figure 2. Notice that only a slight temperature increase of about 5°C occurs when using the control; the associated power is about 3 watts as determined from the calibration curve of Figure 3.

Chemical analysis of the Na_2CO_3 working fluid was done to identify the amount of potassium as a contaminant. The results show potassium levels on the order of 8 ppm. The origin of this potassium and its contribution to the 3 watts of the anomalous heat are currently unknown.

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IV DISCUSSION

The above test results show about 50 watts of anomalous heat are generated at the time hydrogen gas is allowed to diffuse from the nickel tubing into the potassium carbonate solution. Much less heat, on the order of 3 watts, occurs when using the sodium carbonate control. Analyses were done to identify alternative explanations for the source of heat in addition to that proposed by Mills. The results of these analysis are summarized below.

Gas Compression: The excess energy is initiated at the time hydrogen gas is released into the coil of nickel tubing. Analyses were done to determine if the energy released from compression of hydrogen could explain the increase in temperature observed during the experiment. Using the equation: Energy = ½ x Pressure x Volume shows that about 40 joules are generated during gas compression compared to the 9×10^5 joules generated during the five hour test at 50 watts of excess heat. Clearly, gas compression does not explain the excess heat.

Hydrogen Blanketing: Hydrogen permeates through the wall of the nickel tubing and collects in the nitrogen space above the potassium carbonate solution. Estimates show that within the first hour of the test about 0.3 cc of hydrogen will pass through the tubing wall. This small amount of hydrogen being a better heat conductor than nitrogen will slightly increase the heat transfer coefficient between the cell internals and the upper portion of the nickel cylinder. A modest temperature decrease is expected rather than the 86°C temperature increase observed during the test. Hydrogen blanketing is not expected to be the cause of the excess energy observation.

Chemical Reaction: Hydrogen could react with other material located within the tubing or pressure vessel. For example, the nickel oxide located on the tubing inside diameter will most likely be reduced by hydrogen when heated to 235°C. This reaction would be exothermic. The $NaCO_3$ control shows that, at best, this effect could account for 3 of 50 watts of anomalous heat observed using K_2CO_3.

Mills' Theory[2]: The electron of the hydrogen atom is predicted to fall to fractional energy levels, n = ½, ⅓, ¼, and so on, thereby releasing energy when contacting a resonant energy sink of 27.2 eV. The "ash" of the process is the "shrunken" hydrogen atom called a hydrino. Two hydrinos will react creating a dihydrino molecule forming what is reported by Mills to be an inert gas.[8]

Methods are being perfected by Lehigh University for detecting the hydrino atom.[8] One of these methods, called ESCA (Electron Spectroscopy for Chemical Analysis), has been shown to be capable of identifying the hydrino atom absorbed on the surface of nickel cathodes used in electrolysis of K_2CO_3. This work shows a peak at 54.6 eV the energy predicted by Mills to be the binding energy of the electron for the hydrino atom H(n = ½) in vacuum.

ESCA analyses were also done by Lehigh on a virgin sample of nickel tubing as well as a sample removed from a K_2CO_3 diffusion cell. The results of these analyses show the characteristic hydrino peak at 55 eV for the sample used in the diffusion cell; no peak is seen for the virgin sample. This peak is shown in Figure 4 helping to confirm that excess energy can be produced by diffusion of hydrogen through nickel as well as by electrolysis.

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V CONCLUSIONS

An exothermic reaction occurs when conditions exist for contact between hydrogen atoms and potassium carbonate on a nickel surface. These conditions were achieved by diffusing hydrogen through a nickel tube submerged in a 0.6 M solution of potassium carbonate. This exothermic reaction could be similar to that observed by Thermacore and others during electrolysis when using a nickel cathode in a 0.6 M solution of potassium carbonate. The above conditions for an exothermic reaction are consistent with the theory of Mills[2] where a new form of hydrogen is produced at a lower energy state.

Thermacore is currently working under a U.S. Government contract to reproduce the above experiment in a configuration permitting direct measurement of input and output power. Material analyses will be done before and after the experiment to identify the lower energy hydrogen. Results will become available in the spring of 1994.

REFERENCES

1. Mills, R. and S. Kneizys, "Excess Heat Production by the Electrolysis of an Aqueous Potassium Carbonate Electrolyte and the Implications for Cold Fusion", *Fusion Technology*, 210, (1991), 65-81.

2. Mills, R.L., *Unification of Spacetime, the Forces, Matter, and Energy*, Technomics Publishing Company, Lancaster, PA (1992).

3. Ohmori, T., and M. Enyo, "Excess Heat Evolution During Electrolysis of H_2O with Nickel, Gold, Silver and Tin Cathodes", *Fusion Technology*, 24 (1993), pp. 293-295.

4. Noninski, V., "Excess Heat During the Electrolysis of a Light Water Solution of Potassium Carbonate with a Nickel Cathode", *Fusion Technology*, 21 (1992), pp. 163-7.

5. Proceedings: Third International Conference on Cold Fusion, Nagoya, Japan, October 21-25, 1992.

6. Storms, E., "Measurements of Excess Heat from a Pons-Fleischmann-Type Electrolytic Cell Using Palladium Sheet" *Fusion Technology*, 3, 230, (1993).

7. Mills, R., W. Good, and R. Shaubach, "DiHydrino Molecule Identification", *Fusion Technology*, January (1994), in progress.

8. Mills, R. and W. Good, "Fractional Quantum Energy Levels of Hydrogen", Phys. Letts. A, in progress

9. Rees, L.B., "Cold Fusion: What Do We Know? What Do We Think?" *Journal of Fusion Energy*, Vol. 10, No. 1 (1991), pp. 116.
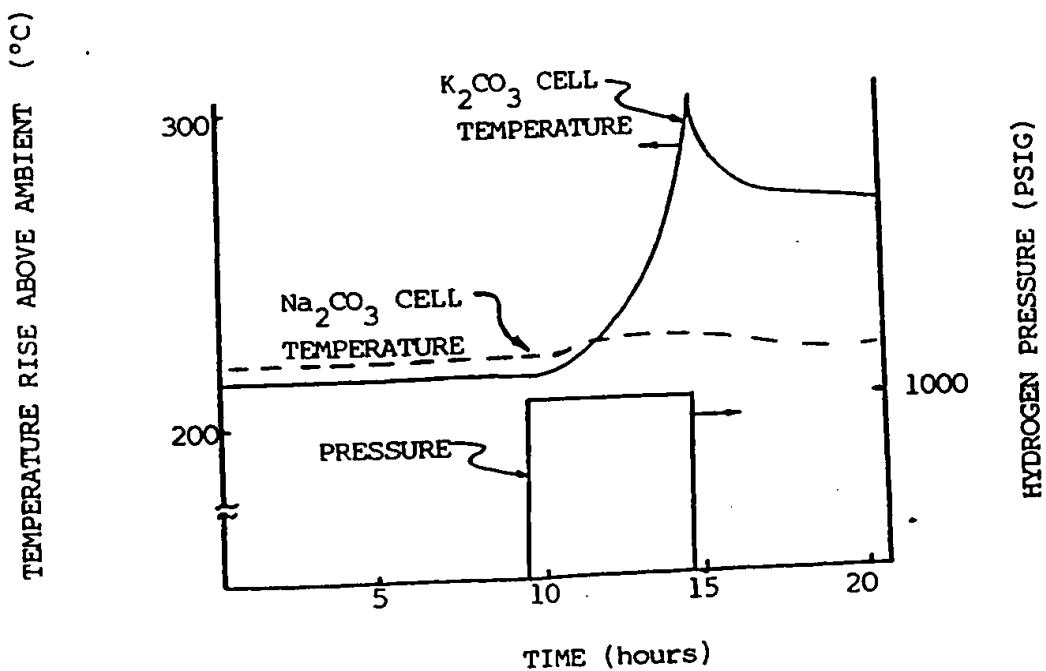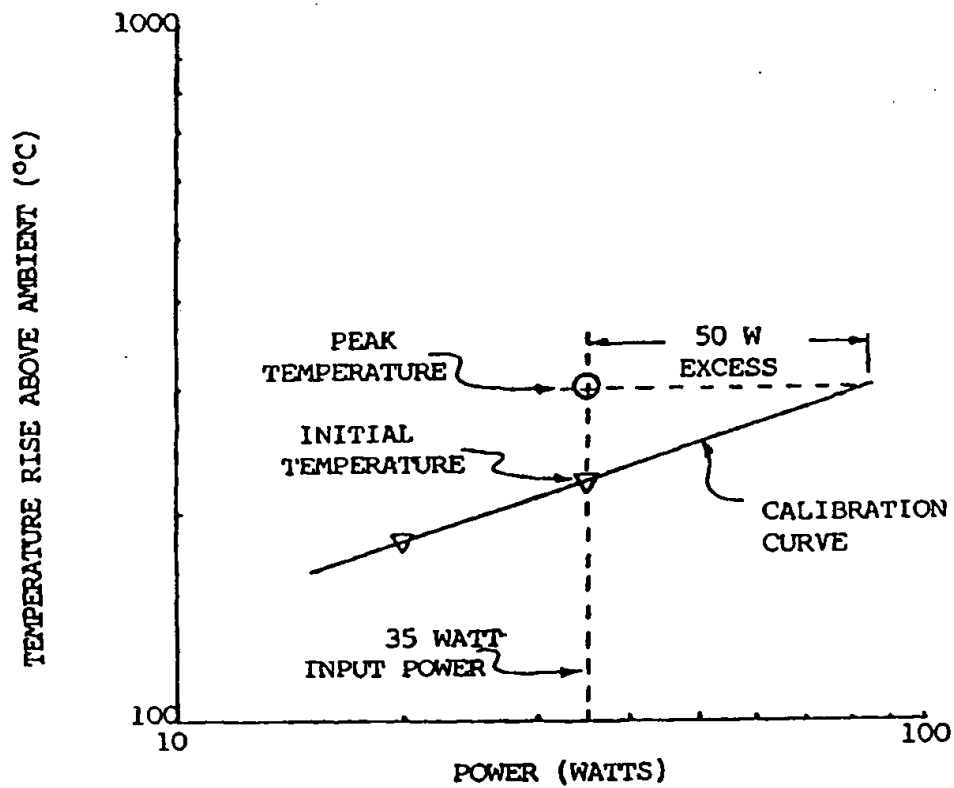
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PRESSURE RELIEF

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K_2CO_3 SOLUTION

PRESSURE VESESL

THERMOCOUPLE

F-2

TEMPERATURE RISE ABOVE AMBIENT (°C)

HYDROGEN PRESSURE (PSIG)

300

K_2CO_3 CELL TEMPERATURE

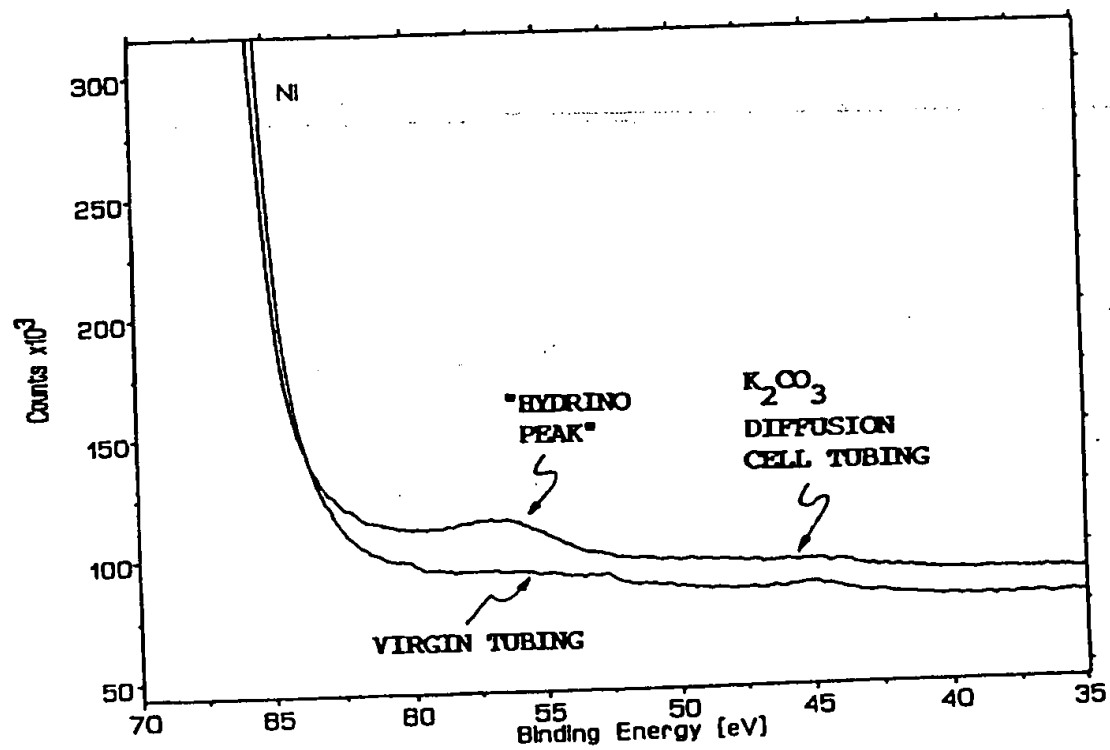Na_2CO_3 CELL TEMPERATURE

1000

200

PRESSURE

5   10   15   20

TIME (hours)

F-3

F -4
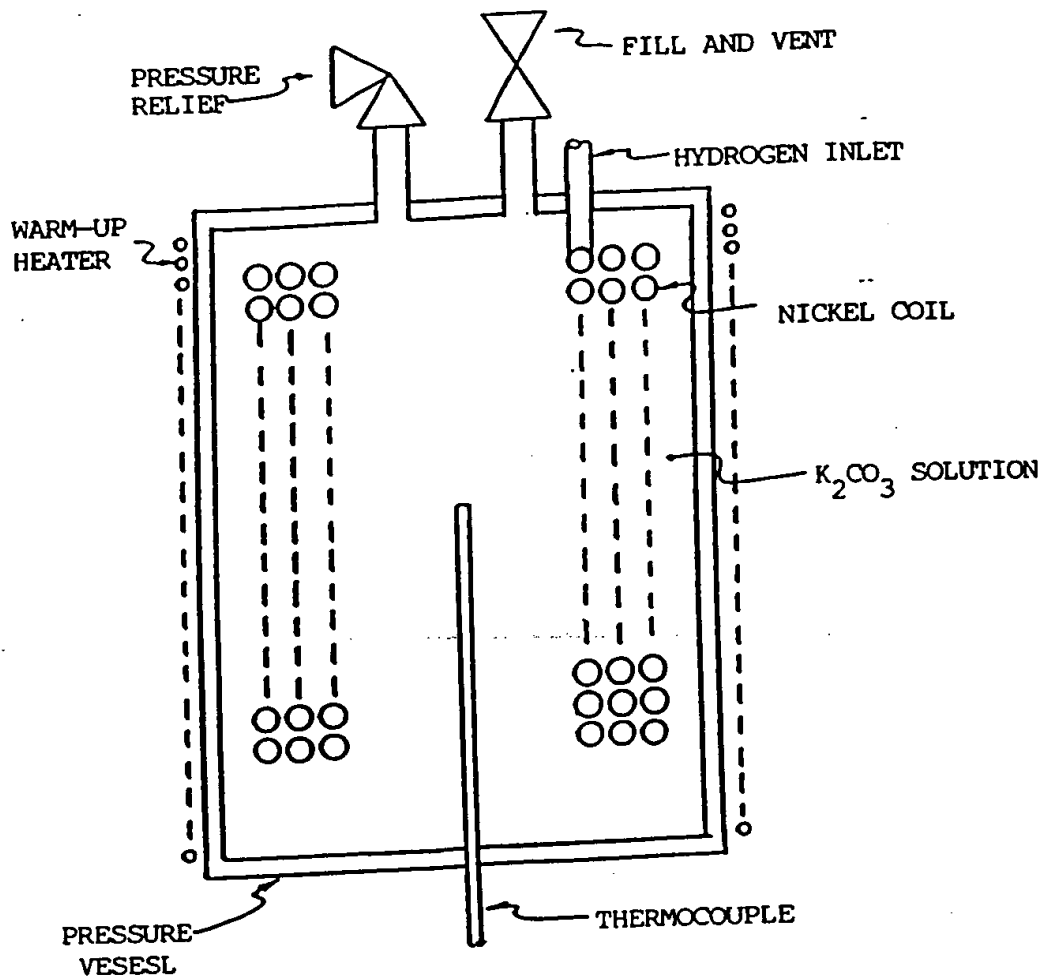
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THERMACORE
INC

CONTRACT NUMBER F33615-93-C-2326

FINAL REPORT

SBIR PHASE I

NASCENT HYDROGEN: AN ENERGY SOURCE

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PREPARED FOR:

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13. ABSTRACT (Maximum 200 words)

Anomalous heat was measured from a reaction of atomic hydrogen in contact with potassium carbonate on a nickel surface. The nickel surface consisted of 500 feet of 0.0625 inch diameter tubing wrapped in a coil. The coil was inserted into a pressure vessel containing a light water solution of potassium carbonate. The tubing and solution were heated to a steady state temperature of 249°C using an I^2R heater. Hydrogen at 1100 psig was applied to the inside of the tubing. After the application of hydrogen, a 32°C increase in temperature of the cell was measured which corresponds to 25 watts of heat. Heat production under these conditions is predicted by the theory of Mills where a new species of hydrogen is produced that has a lower energy state then normal hydrogen. ESCA analyses, done independently by Lehigh University, have found the predicted 55 eV signature of this new species of hydrogen. Work is continuing at Thermacore with internal funding to bring this technology to the marketplace.

14. SUBJECT TERMS
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ACKNOWLEDGEMENT

2.0 INTRODUCTION

It has been more than fifty years since a new source of thermal energy (nuclear fission) was brought into service. On March 23, 1989, two chemists, Stanley Pons and Martin Fleischmann, claimed to have experienced fusion, the energy source of the sun, by electrolysis in a test tube of water at room temperature. This process was called "Cold Fusion." Since then, thousands of scientists around the world have been attempting to explain and replicate this new source of thermal energy.

In April 1991, Dr. Randell Mills presented a theory and a power-producing electrolytic cell whose output was continuous, predictable and appreciably greater than the electrical input. The theory for the excess heat is described in a Mills and Kneizys paper[1] that was published in the April 1991 issue of Fusion Technology. According to the theory, the source of the heat is the "electrocatically induced reaction whereby hydrogen atoms undergo transitions to quantitized energy levels of lower energy than the conventional ground state. These lower energy states correspond to fractional quantum numbers." Excess heat is produced while making a new form of hydrogen which is completely different than the fusion reaction reported by Pons and Fleischmann. Dr. Mills named this new form of hydrogen "hydrino" which is latin for baby hydrogen. The hydrino is created in the electrolytic cell when atomic hydrogen comes in contact with potassium carbonate on a nickel cathode. This excess heat was confirmed by Thermacore and other researchers[2,3,4] that used the Mills' approach.

As research continued, Thermacore began moving away from the electrolytic approach and towards higher operating temperatures. Electrolytic cells are limited to the maximum operating temperature of 100°C, unless enclosed in a pressure vessel. Operating an electrolytic cell in a pressure vessel was not considered prudent due to the danger of explosion from the evolving mix of oxygen and hydrogen.

Operating at higher temperatures has advantages. For example, many chemical reactions are enhanced as temperature is increased thus more excess heat might be possible. Plus, exploring higher operating temperatures moves this technology in a direction that will most benefit the world in the form of environmentally safe electric power generation.

Thermacore, Inc., under IR&D funds, showed that the energy producing feature of these electrolytic cells can be achieved without the need for electrolysis. The nickel cathode of the Mills' electrolytic cell was replaced with a thin walled nickel tube containing high pressure

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FIGURE 1a. <u>NON-ELECTROLYTIC CELL</u>
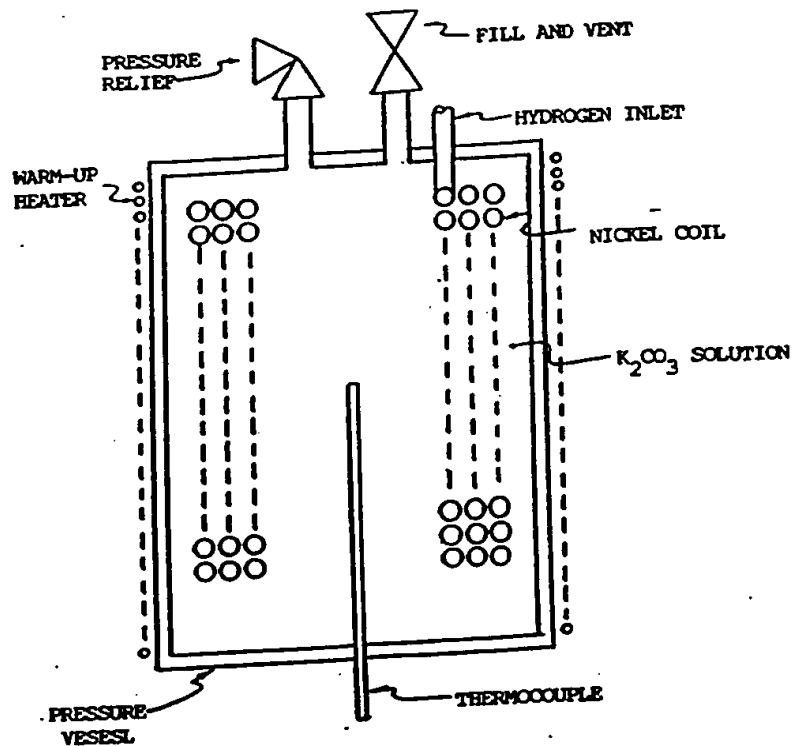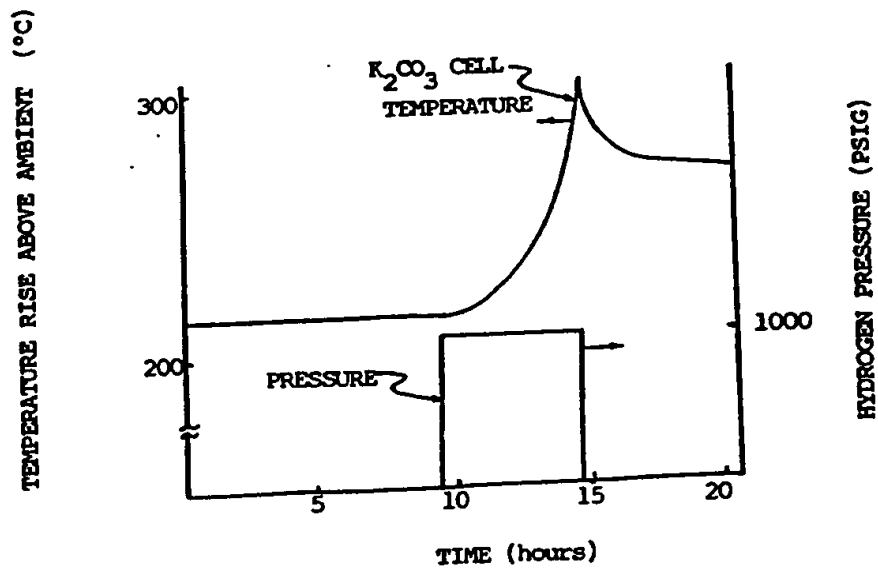

FIGURE 1b. <u>NON-ELECTROLYTIC CELL RESPONSE TO HYDROGEN</u>

3.0 CONCLUSIONS AND RECOMMENDATIONS

Excess heat energy was measured at an average level of 24.3 watts ± 6.4 watts. Our confidence to report excess heat comes as a result of repeated testing and reevaluation of the test procedures and that the shrunken hydrogen molecule has been identified by an independent university.

The electron of the hydrogen atom is predicted by Mills to transition to fractional energy levels releasing energy when contacting an energy sink resonant with the hydrogen energy released. The "ash" of the process is the "shrunken" hydrogen atom called a hydrino.

Lehigh University (Dr. A. Miller), Bethlehem, PA, using ESCA (Electron Spectroscopy for Chemical Analysis)[6] has found the hydrino molecule absorbed on the surface of nickel cathodes used in electrolysis of K_2CO_3. This work shows a peak near 55 eV which is predicted by Mill's to be the binding energy of the electron for a hydrino molecule. Lehigh's exhaustive evaluations have found no other explanation for this peak.

ESCA analyses were also done by Lehigh on samples of nickel tubing removed from coil #4[7]. The results of these analyses show the characteristic hydrino peak at 55 eV. This peak is shown in Figure 2, confirming that excess heat can be produced by diffusion of hydrogen through nickel contacting K_2CO_3 as well as by electrolysis. As a result of the work done by Lehigh University and Thermacore on this effort, we conclude that the Mills' theory is the likely explanation for the excess energy seen in the experiments done under this program.

Despite the considerable work conducted in this Phase I effort, the parameters that significantly enhance excess heat production remain unknown. Enhancement by at least a factor of 10 to 100 is required to make this technology feasible for commercial use. Much work remains as shown in Table 1; Thermacore is currently pursuing this work on internal funding.

The key to increasing excess heat production will probably be realized after obtaining a better understanding of the interactions between the potassium carbonate and the atomic hydrogen on or within the nickel surface. This interaction is related to the condition of the nickel material, orientation of the potassium carbonate molecule, and desorption of H_2 and the "shrunken" hydrogen from the nickel surface. Much of this understanding could be obtained experimentally by conducting numerous small scale tests varying a single parameter at a time. When an improvement is noted, extensive analysis of the surface should be conducted. This work will be recommended for the Phase II effort.

FIGURE 2. COMPARISON OF ESCA RESULTS FOR VIRGIN TUBING
COMPARED TO TUBING FROM K₂CO₃ DIFFUSION CELL
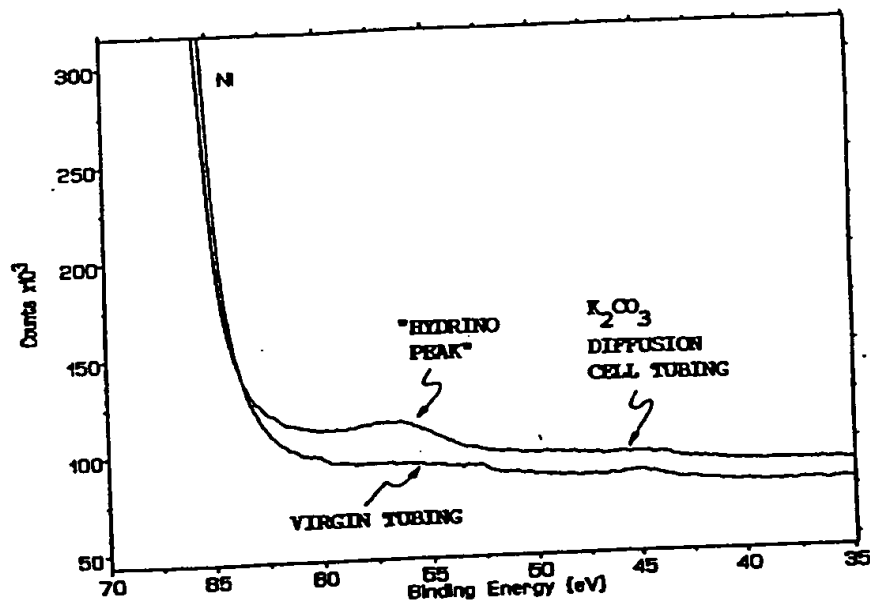
TABLE 1. Status of Investigation of Parameters in the Mills Process

PROCESS STEP	PARAMETER INVESTIGATED	UPCOMING TESTS*
Step 1: Adsorption of H₂ on inner diameter of the nickel tubing	General Cleaning, Oxide Layer	Investigate other oxides
Step 2: Disassociation of the hydrogen molecule into atomic species	none	none
Step 3: Diffusion of H₁ through the nickel tubing	Varied Hydrogen Pressure and Temperature	none
Step 4: Contact between atomic hydrogen and potassium carbonate	Loosely Wound Coil	none
Step 5: Transition the H₁ to a lower energy state	Cell Voltage,Nickel Temper,General Cleaning,Varied Electrolyte Concentrations	Conduct Extensive Analyses of Nickel Surface
Step 6: Recombination of H₁ into H₂	none	none
Step 7: Desorption of H₂ and the "shrunken" hydrogen from the nickel surface	Applied Vibrations	Stir or Ultrasonics

*Thermacore is continuing the test program with internal funding.

4.0 TECHNICAL DISCUSSION

This section of the report documents the results of the work conducted in this Phase I program and it is divided into the following sections:

4.1 CELL DESIGN

4.2 CELL CALIBRATION

4.3 SCALING PARAMETERS

4.4 TEST RESULTS

4.5 EVALUATION OF TEST RESULTS

4.1 CELL DESIGN

The test cell consists of a five inch diameter Schedule 80 pressure vessel with removable cover plate, as shown in Figure 3. Specific information about the cell is listed in Table 2. An electric cartridge heater is used to raise the temperature of the apparatus to facilitate the permeation of hydrogen through the wall of the nickel tube. A thermocouple well is provided to allow insertion of a Type K thermocouple used to measure the temperature of the electrolyte in the vicinity of the coil of nickel tubing.

Heat is removed from the apparatus by conduction through a gas gap to a water cooled heat exchanger welded to the outside of the pressure vessel. The thermal conductivity of the gas gap is controlled by achieving the proper mixture of helium and argon purge gas. The objective is to provide a sufficient temperature difference between the electrolyte and cooling water to avoid boiling the cooling water. This will allow single phase measurement of the power removed from the cell. Figure 4 is a photograph of the completed cell. All interior and exterior surfaces were plated with electroless nickel to assure compatibility with the electrolyte. In preparation for calibration and testing, the cell was wrapped with 2" thick high temperature ceramic fiber insulation.

Five coils of nickel tubing were fabricated. Figure 5 is a photograph of a typical coil; coil details are provided in Table 3.

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FIGURE 3. TEST CELL DESIGN

TYPE -K THERMOCOUPLE

PRESSURE RELIEF VALVE

ANODE

VACUUM/H$_2$ PURGE

ELECTROLYTE CHARGING VALVE

HYDROGEN IN

COVER PLATE

HIGH TEMPERATURE GASKET

THERMOCOUPLE WELL

ELECTROLYTE LEVEL

He/Ar →

→ H$_2$O OUT

THERMOCOUPLE IN WATER LINE

K$_2$CO$_3$ CATALYST

COIL OF CU TUBING BRAZED TO HX

GAS GAP CALORIMETER

H$_2$O IN

→ He/Ar

THERMOCOUPLE IN WATER LINE

HEMI-END CAP

COIL OF NICKEL TUBING

DRAIN PORT

CARTRIDGE HEATER
(USED TO RAISE TEMPERATURE OF CELL TO INITIATE H$_2$ PERMEATION)

12\2015\ FIG 2. DWG

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TABLE 2. Test Cell Description

PARAMETER	MAGNITUDE
Flange and Cover Plate	300 lb
Diameter	13"
Thickness	1.5"
Material	Carbon Steel
Design	ANSI B36.2
Gasket	
Manufacturer	Flexitallic, Inc.
Model	Flexicarb-graphite/304 S.S. wound
Pressure Vessel	5" Schedule 80
Material	304 s.s.
Length	6"
Hemispherical Endcap	5" Schedule 80
Material	304 s.s.
Design	ANSI B36.19
Gas Gap Heat Exchanger	Copper Tubing Wrapped and Brazed to Shell of Gas Gap Calorimeter
Material	304 s.s.
Gap Width	0.07"
Length	5"
Voltage	220
Cartridge Heater	Watlow, Inc.
Power	750 W
Diameter	0.5"
Length	4"
Cell Internal Volume	2000 cc's
Anode Penetration	Conax Fitting
Part No.	MTG-24-A-2-L
Anode Material	0.02" diameter nickel wire
Thermocouple	0.0625" diameter, Type K, s.s. sheathed, Ungrounded

FIGURE 4. TEST CELL PHOTOGRAPH

FIGURE 4. TEST CELL PHOTOGRAPH

H₂ OUTLET H₂ INLET

PRV

VENT VALVE

REMOVABLE COVER PLATE

GAS OUTLET

WATER H Xer

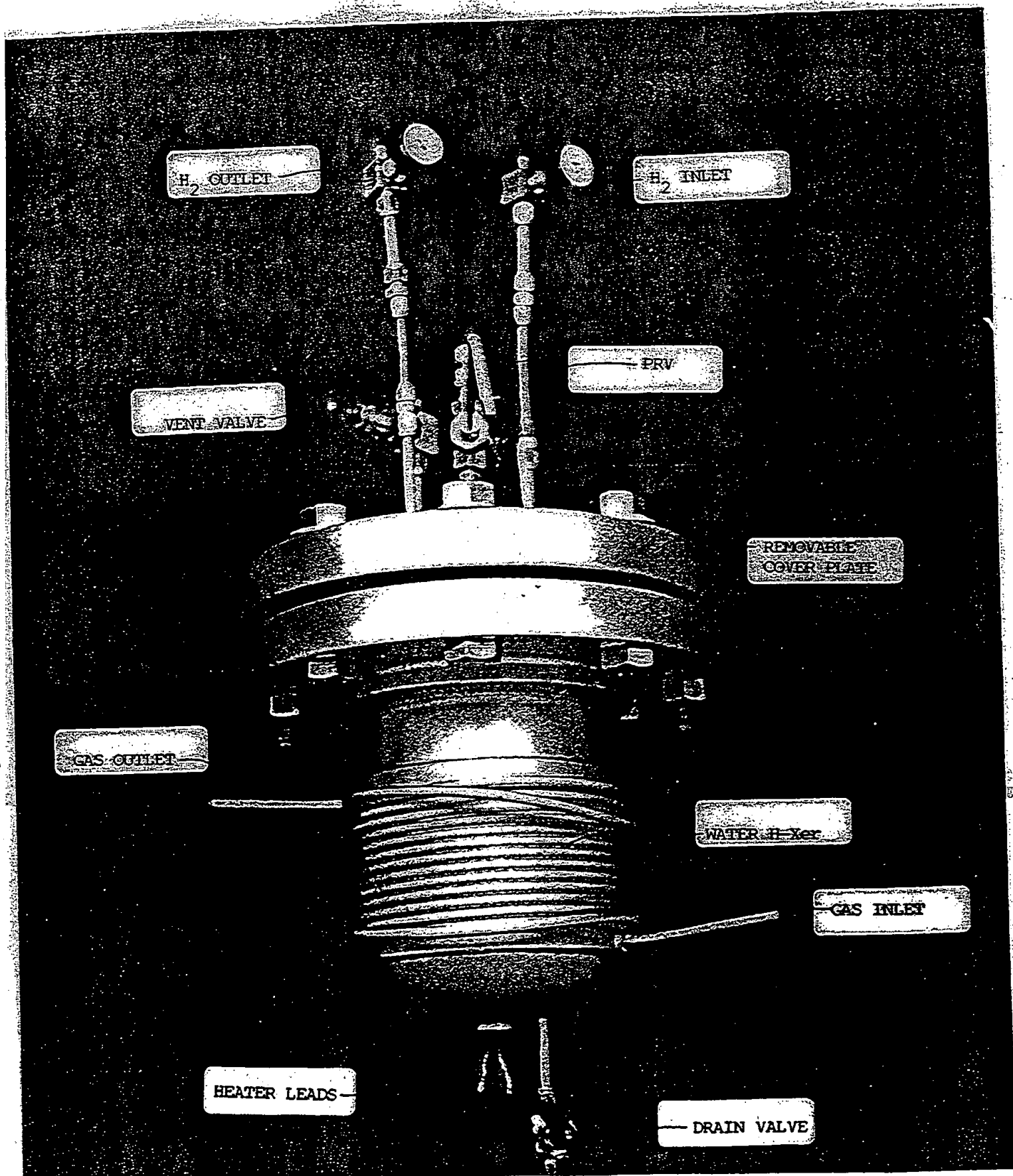GAS INLET

HEATER LEADS

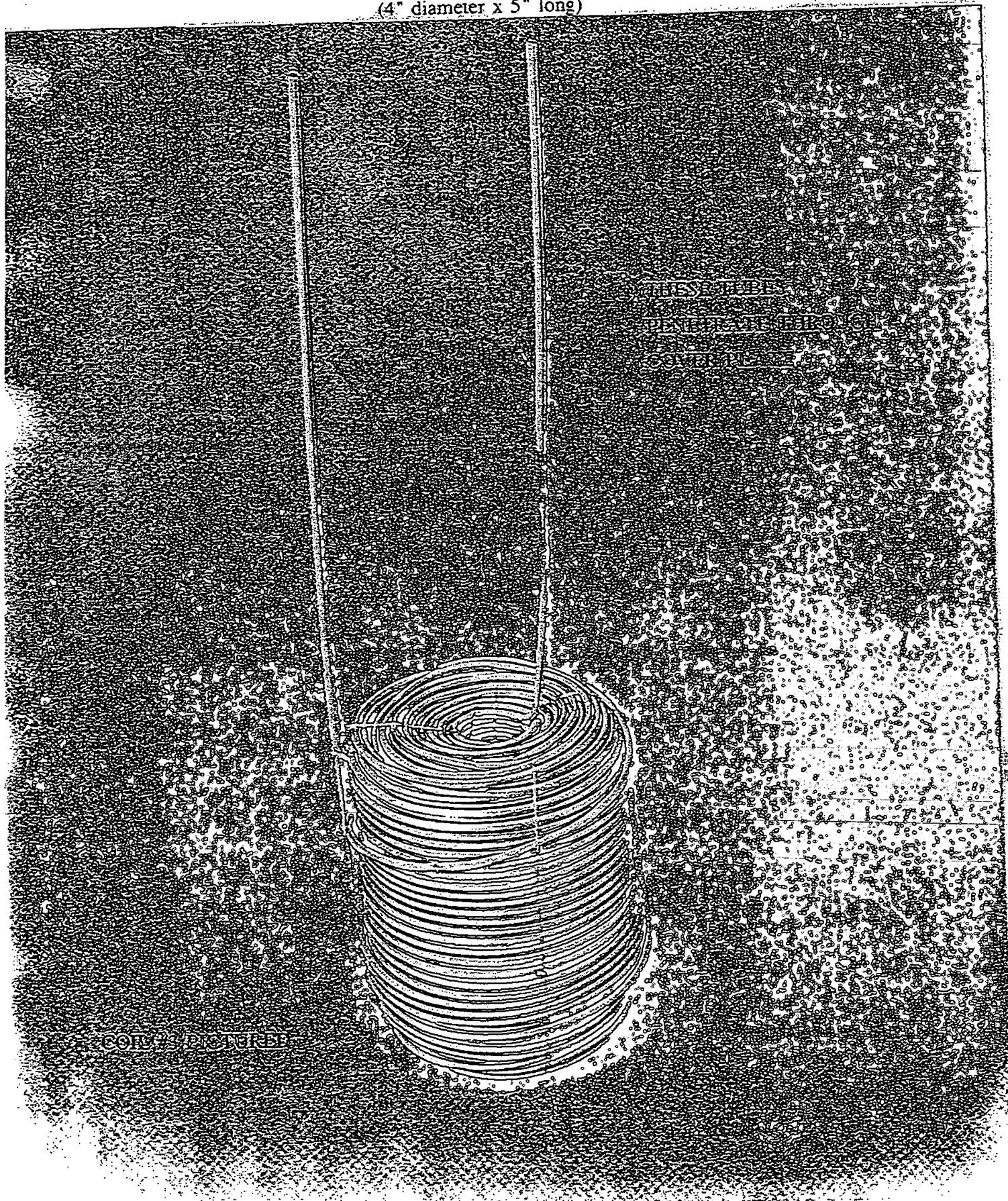DRAIN VALVE

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FIGURE 5. COIL OF NICKEL TUBING
(4" diameter x 5" long)

TABLE 3. Nickel Coil Information

COIL #	DESCRIPTION	PURCHASED FROM	HEAT #/STRENGTH INFORMATION	MISC. INFORMATION	COIL SIZE
1	250' of annealed nickel 200 tubing; 0.125" dia x .010" wall	The Micro Group, Inc. 7 Industrial Park Road Medway, MA 02053	Heat #: N82J8A Tensile: 71,800 psi Yield: 33,500 psi	Tube connections made using Nicrobraze 125.	3.5" dia x 6" long
2	250' of annealed nickel 200 tubing; 0.125" dia. x 0.010" wall	The Micro Group, Inc. 7 Industrial Park Road Medway, MA 02053	216 ft of Heat #: NOON8A 59 ft of Heat #: N82J8A Strength information: unavailable	Tube connections made using Nicrobraze 125.	4" dia x 5.25" long
3	250' of hard nickel 200 tubing; 0.125" dia. x 0.010" wall	Tube Methods, Inc. Rambo & Depot St. P.O. Box 460 Williamsport, PA	Heat #: 71746 Tensile: 101,100 psi Yield: 95,900 psi	Tube connections made using Nicrobraze 125.	4" dia. x 5 " long
4	500' of annealed nickel tubing; 0.0625" dia. x 0.010" wall	The Micro Group, Inc. 7 Industrial Park Road Medway, MA 02053	Heat #: N81K6AG Tensile: 71,700 psi Yield: not listed on cert.	Tube connections made using Nicrobraze 125. This material type was used in the original small non-electrolytic cell tested 12/92	3" dia x 5" long
5	500' of annealed nickel tubing; 0.0625" dia. x 0.010 wall	The Micro Group, Inc. 7 Industrial Park Road Medway, MA 02053	Heat #: N20N8A Tensile: 73,100 psi Yield: Not listed on cert.	Tube connections made using Nicrobraze 125.	4.5" dia. x 5" long

4.2 CELL CALIBRATION

Calibration of the cell was done both with and without water cooling. The selection of the particular calibration technique to be used is dependant upon the amount of excess heat to be detected. Each technique is described below.

4.2.1 Cell Calibration Without Water Cooling

In those instances were the excess heat is below 150 watts a calimetric technique without the use of water cooling is used. Cell calibration is done by measuring the cell's temperature rise above ambient as a function of input power. This calibration is done on a fully insulated cell with a coil submerged in K_2CO_3 without hydrogen applied to the inside of the tubing. Figure 6 is the calibration curve for the cell. With this information, any excess heat generated during an experiment is a direct function of the cell temperature and will be detected as follows:

Excess Heat = Heat Lost to Environment (determined using Figure 6) - Input Electrical Power

This technique is accurate within the limits of the instruments used to measure electrical power and temperature. Section 2.5 (Paragraph 3-Instrument Error) of this report shows the instruments to be accurate within 1%.

4.2.2 Calibration Using Water Cooling

At power levels greater than 150W, water cooling of the cell is required to remove the heat and maintain the cell in the 200°C to 300°C range. Cell calibration was conducted on a fully insulated cell with nickel tubing submerged in 0.6 molar K_2CO_3 without hydrogen applied to the inside of the tubing. The calibration procedure determined the amount of heat lost to the environment as a function of cell temperature above ambient as follows:

Heat Lost = Input Electrical Power - Heat Removed
to Environment   by the Cooling Water

Where,

Input Electrical Power = Volts x Amperes

Water Power = $\dot{m}Cp \, \Delta T$

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Figure 6. Cell 2: Calibration
No Cooling Water or Gas Purge Used

Calibration Conditions:
Coil In Cell
0.6M K2CO3 In Cell
350 psig Nitrogen Overpressure
No Hydrogen Applied

CALIB3 Mar. 16, 1994 2:11:39 PM
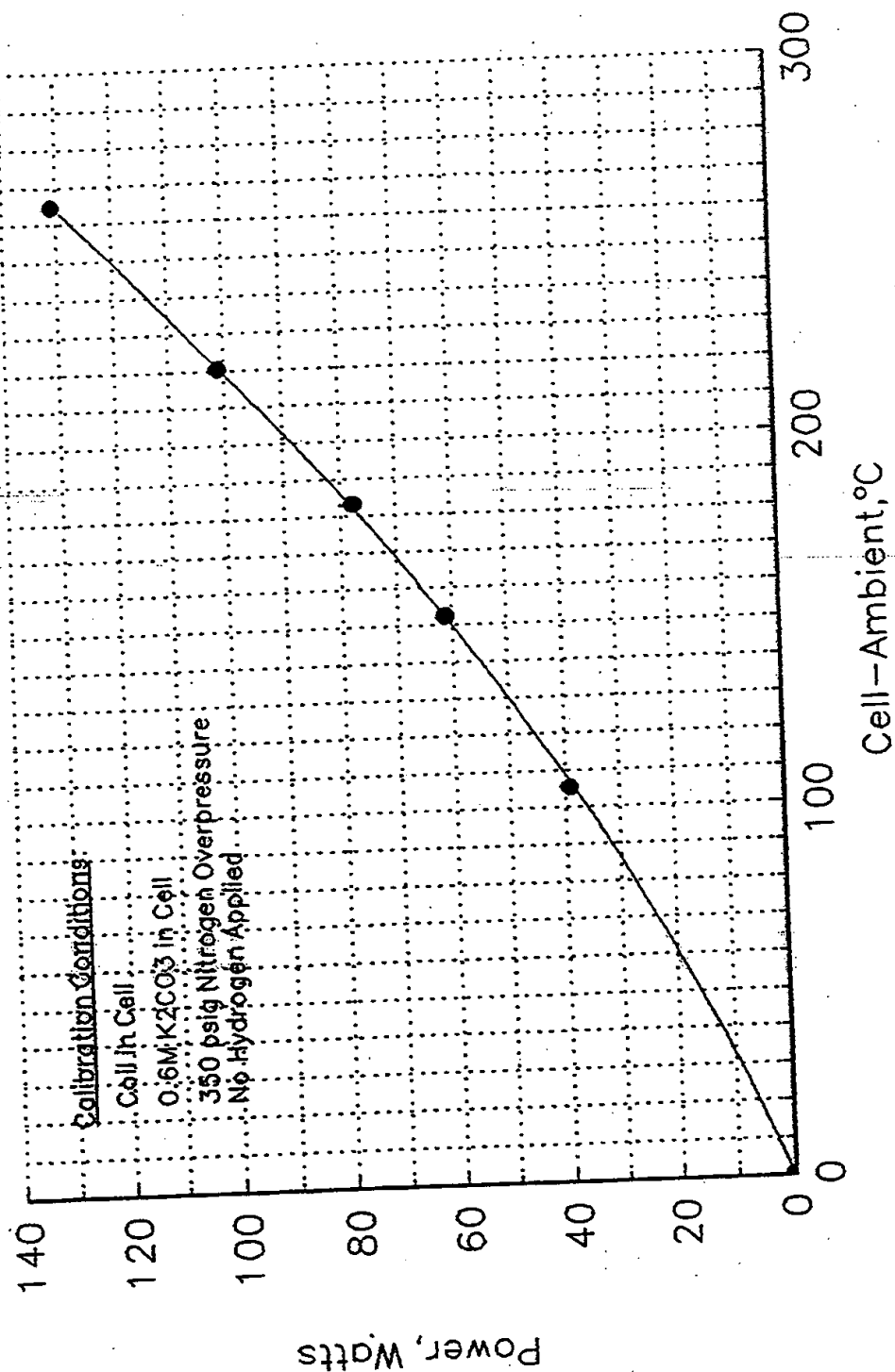
Subtracting the heat removed by the water from the input power yields the heat loss from the cell. This heat loss includes the convective and radiative heat loss from the cell and the heat removed by the argon that is flowing at a constant rate in the gas gap. Figure 7 shows the heat loss calibration curve for the cell. With this information, any excess heat generated during an experiment is detected as follows:

Excess Heat = Heat Removed by the Water Cooling - Heat Lost to the Environment
(determined using Figure 6) - Input Electrical Power

It is important to note that the water flow rate was not constant throughout the test; at some points during testing it fluctuated $\pm$ 25 cc's/minute. Ultimately, this fluctuation translates into a heat balance accuracy of $\pm$ 50 watts. This accuracy was considered reasonable at the start of the test since we expected to measure excess heat greater than 500 watts.

4.3 SCALING PARAMETERS

The overall heat generation process occurring in this cell is believed to involve the following steps:

Step 1: Absorption of the hydrogen molecule on the inner surface of the nickel tubing.

Step 2: Disassociation of the hydrogen molecule into atomic hydrogen.

Step 3: Diffusion of the atomic hydrogen through the nickel tubing.

Step 4: Contact between some of the atomic hydrogen and the potassium carbonate catalysis on the outer surface of the nickel.

Step 5: Transition to a lower energy state of the atomic hydrogen that contacts potassium carbonate. This hydrogen atom will release energy and be "shrunken" in size.

Step 6: Recombination of those hydrogen atoms that do not undergo the transition into molecular hydrogen.

Step 7: Desorption of molecular hydrogen and the "shrunken" hydrogen from the surface.

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Figure 7. Cell 1 : Calibration Curve
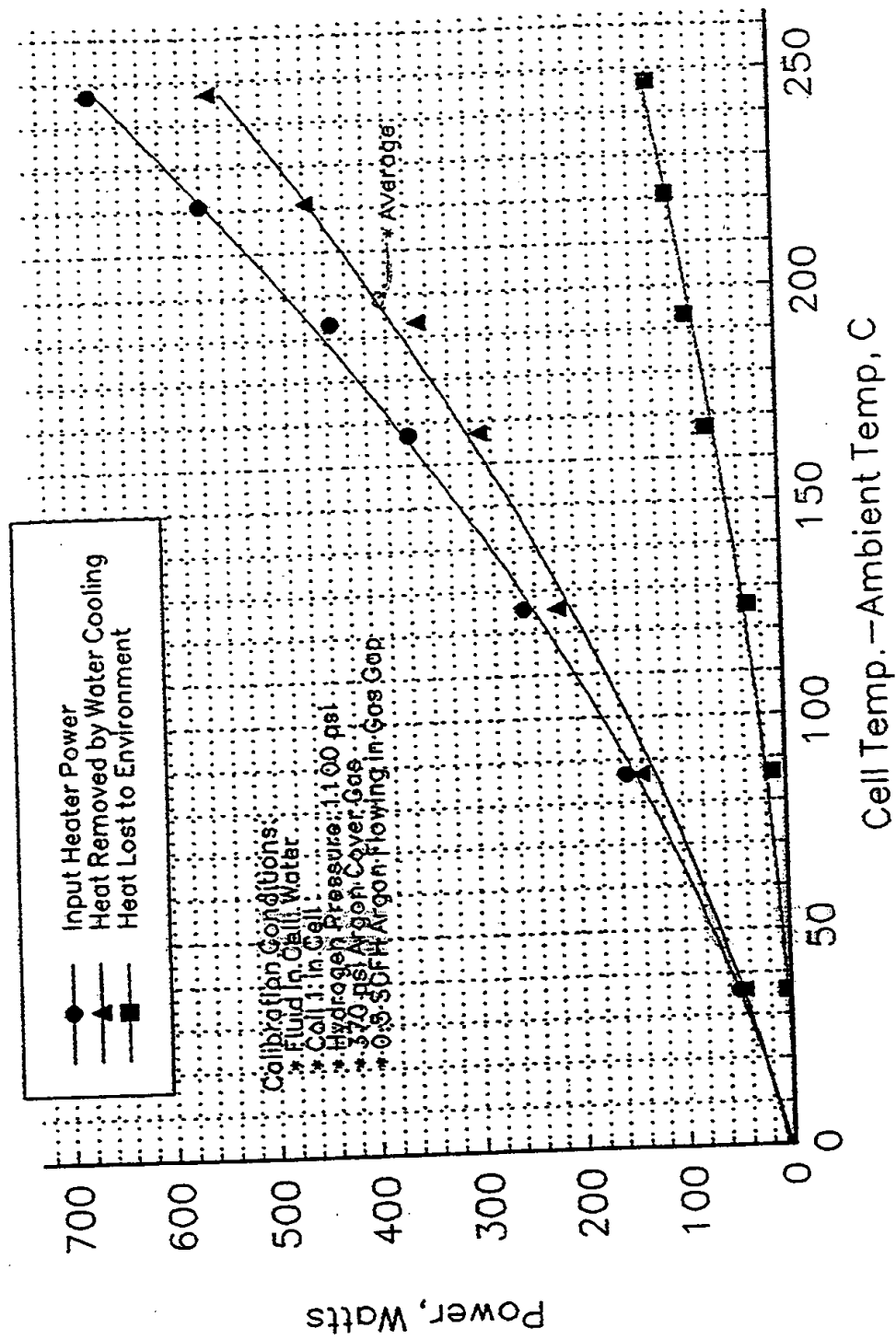
Steps 1, 2, 3, 6 and 7 are consistent with diatomic gas permeation theory. Ultimately, one or more of the above steps will most likely limit the rate of excess heat production. Work was conducted in this effort to investigate parameters that affect the above mentioned seven steps. The parameters that were investigated include: hydrogen pressure and temperature, oxide layer, nickel surface preparation, nickel tubing temper, electrolyte concentration, cell voltage, and hydrino concentration. A brief description of each parameter is provided below.

■ Hydrogen Pressure and Temperature

The relationship of hydrogen pressure and temperature to the flow of atomic hydrogen through the tubing wall is expressed by:

$$\dot{m} = \varnothing \frac{2\pi L}{\ln(r_o/r_i)} (P_i^{1/2} - P_o^{1/2}) \tag{1}$$

Where

$\dot{m}$ = hydrogen mass flow, μ mol s^{-1}
$\varnothing$ = permeability, μ mol s^{-1} m^{-1} kPa$^{-1/2}$
L   = tubing length, m
P_i = input pressure, kPa
P_o = output pressure, kPa
r_o = outer tube radius, m
r_i = inner tube radius, m

This equation shows that permeation increases as a square root of the pressure. The $\varnothing$ in equation (1) relates the permeation rate to temperature, as follows:

$$\varnothing = \varnothing_o \, e^{-\frac{\Delta H_p}{RT}} \tag{2}$$

Where,

$\varnothing_o$ = a constant
ΔH_p = activation energy
R   = gas constant
T   = absolute temperature (K)

Equation (2) and a large body of experimental data show that log $\varnothing$ plotted vs 1/T will yield a straight line as shown in Figure 8. Figure 8 shows that the permeation rate goes up exponentially with temperature. Overall, the combined affect of the two parameters is an

FIGURE 8. HYDROGEN PERMEABILITY RATES AS A FUNCTION OF TEMPERATURE [8]

PERMEABILITY RATES OF VARIOUS METALS

1= 430 SS
2= PURE Ni
3= IN. 625
4= IN. 716
5= 316 SS
6= 321 SS
7= 18SR (T)
      321 (AL/AL$_2$O$_3$/AL)
8= 18SR
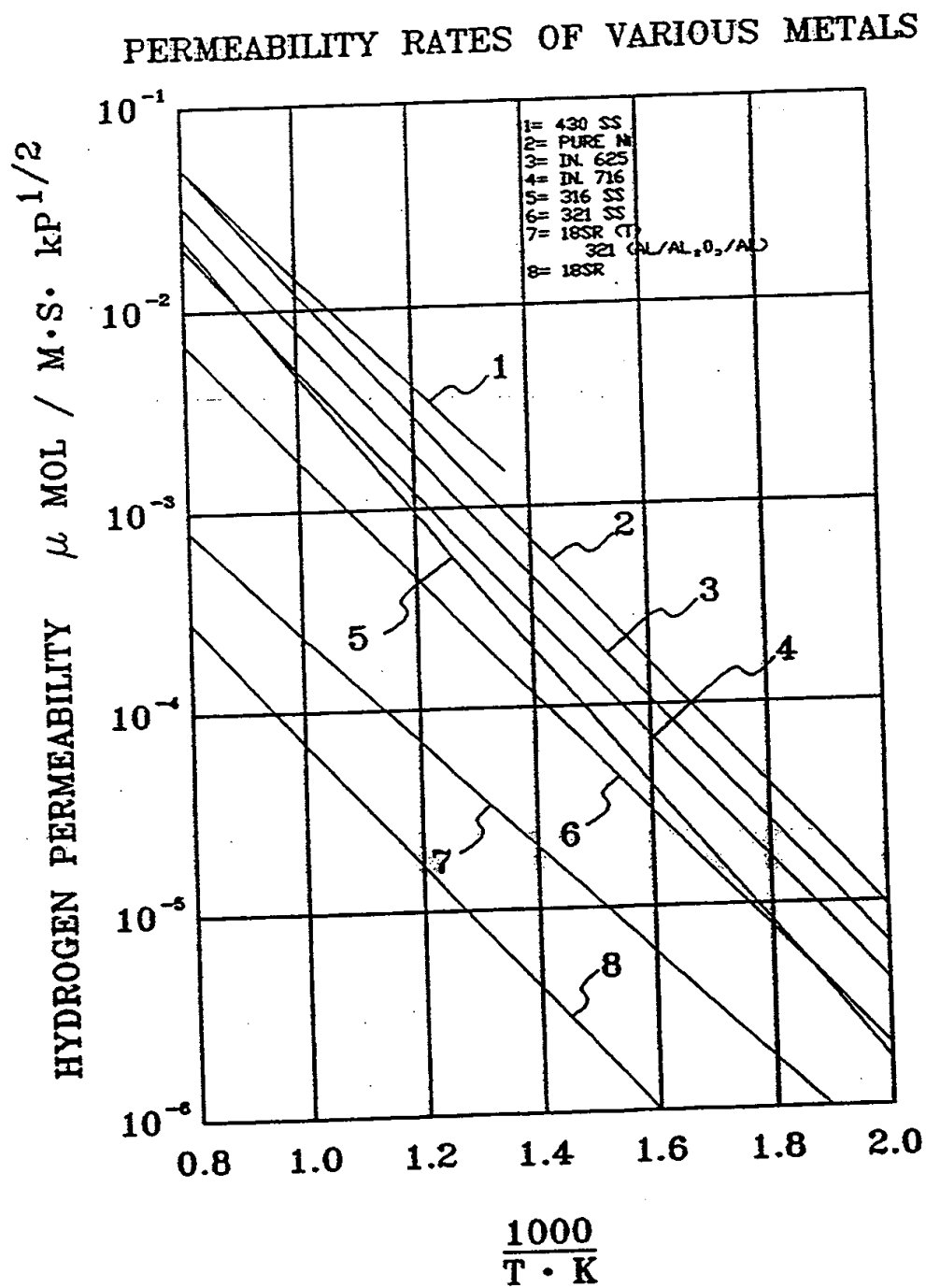
increase in the amount of atomic hydrogen available to undergo the transition to a lower energy state.

Calculations, documented in Appendix A, show that for a constant hydrogen pressure of 1100 psig, the volumetric flow of hydrogen diffusing through the nickel tubing is approximately 0.05 cc's/sec at 200°C and 0.8 cc's/sec at 300°C. The resulting excess power that can be generated by this amount of hydrogen flow was estimated in Appendix B using Mills' theory. The results are described below:

ELECTRON TRANSITION FROM GROUND STATE TO FRACTIONAL QUANTUM LEVEL, n	EXCESS POWER (WATTS)	
	200°C	300°C
2	5	67
3	14	178
4	26	334
5	41	534

- Oxide Layer - The oxide layer is expected to affect the amount of hydrogen absorbed on the nickel surface. Kohl[9] shows an abnormal enrichment of hydrogen on nickel when the surface is covered by a visible film of nickel oxide. Kohl states that *"The concentrations of hydrogen observed in the presence of oxide films not only were substantially higher than those observed with pure nickel, but also increased with decrease of temperature from near 200°C to near 100°C. For equal number of atoms striking the surface, the increase in concentration near 100°C amounts to about four orders of magnitude."* If adsorption of the hydrogen is a rate controlling step then the formation of an oxide layer should enhance the process.

- Nickel Surface Preparation - This parameter addresses the condition of the inner and outer surfaces of the nickel as they apply to Steps 1 and 4 of the process. In general, the nickel surfaces must be free of any contaminants that will inhibit Steps 1 and 4. Generally, these contaminants are dirt, oils, greases, and undesired oxides. Some of the cleaning methods used to remove these contaminants may actually introduce other

contaminants. For example, trace amounts of some organic solvents may be left behind. It is unknown at this point whether solvents have a negative affect on the process. Perhaps the diatomic hydrogen that forms in Step 6 may be a contaminant that occupies space on the surface, thus preventing atomic hydrogen from contacting potassium carbonate.

- Electrolyte Concentration - The small non-electrolytic cell tested by Shaubach and Gernert used a weak potassium carbonate solution. Tests have been conducted to determine if the excess heat generation process can be enhanced through the use of more concentrated solutions.

The following parameters affect Steps 4 and 5 of the process. They are mainly supported by observations that resulted from small electrolytic experiments conducted prior to this contract.

- Nickel Tubing Temper - Tests conducted by HPC and Thermacore in small electrolytic cells seem to indicate that the catalytic reaction is related to nickel hardness. To determine if this parameter applies to the non-electrolytic approach, a coil of annealed and a coil of hard nickel tubing were tested.

- Cell Voltage - Tests conducted in small electrolytic cells have indicated that a nickel cathode left in the potassium carbonate electrolyte without a negative electrical charge becomes ineffective. It is thought that the electrical charge either conditions the surface or keeps unwanted contaminants away. To evaluate this affect, we have provided an anode in the 500 watt permeation cell. A charge can safely be applied to the cell as long as the anode to cathode potential difference is kept below the 1.48 volts required for the disassociation of water.

- Hydrino Concentration - Hydrocatalysis Power Corporation tests using invented electrolytic cells with hydrogen/oxygen recombiners show that there is an equilibrium pressure occurring after several days of operation. After this equilibrium pressure is reached, the excess heat process ceases. If this is the case, the closed cell approach should shut down excess heat production after an extended period of time, unless the potassium carbonate side of the cell is periodically vented.

All of these parameters have been evaluated as described in the next section.

4.4 TEST RESULTS

Five coils of nickel tubing were tested. The test results for each coil are described below.

4.4.1 Coil #1: 250' of 0.125" Diameter Annealed Tubing

The exterior surface of the tubing as received from the manufacturer was oily and dirty. To remove the oil, the exterior was wiped with an acetone saturated towel. The tubing coil was placed in an ultrasonic cleaner filled with liquinox and deionized water. After cleaning, the coil was rinsed in deionized water, inserted in the cell and tested using the water cooled calorimeter approach.

Nine different test conditions were conducted to evaluate the various parameters described in Section 4.3. The conditions and results are documented in Table 4. No excess heat above the 50W detection limit was measured under any of the test conditions.

Since the tubing was cleaned with an organic material, we thought the lack of excess heat may be due to poisoning of the surface from the acetone. As a result, a new coil was inserted in the cell.

4.4.2 Coil #2: 250' of 0.125" Diameter Annealed Tubing

The tubing delivered from the factory was also dirty and oily. Prior to wrapping the coil, the tubing was cleaned by hand using soap and water. After wrapping, the coil was further cleaned in an ultrasonic cleaning vessel filled with soap (liquinox brand) and distilled water followed by rinsing with water.

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TABLE 4. Test Conditions and Results for Coil #1 - 250' of Annealed Nickel Tubing*

TEST #	TEST DESCRIPTION	CONDITIONS	RESULTS				
			CELL ΔT (°C)	INPUT POWER, (watts)	HEAT REMOVED BY WATER, (watts)	HEAT LOST TO ENVIRONMENT (watts)	Q_{excess} (watts)
1	High K₂CO₃ Concentration	- 0.6 M K₂CO₃ Electrolyte - 1500 psi H₂ pressure applied at start of test - 370 psi Argon over pressure applied above electrolyte	226	544	481	105	+42
2	Hydrino Concentration	- Removed electrolyte from Test #1 and added a fresh charge of 0.6 M K₂CO₃ - 370 psi Argon over pressure applied above electrolyte - Heated the cell to 238°C steady state - Applied 1200 psi H₂ pressure	210	492	400	92	0
3	Oxide Layer	- Released the hydrogen pressure from Test #2 - Purged inner diameter of tubing with air - Allowed to sit overnight open-to-air - In morning, applied 1100 psi H₂ pressure	205	485	394	90	-1
4	Cleaned the Inner diameter of the tubing	- Cleaned the inner diameter of Nickel tubing with a 6% by volume solution of H₂O₂ and water - Heated the cell to 235°C steady state - Applied 1100 psi H₂ pressure	209	495	423	91.5	+19.5

TABLE 4. Test Conditions and Results for Coil #1 - 250' of Annealed Nickel Tubing*
(continued)

TEST #	TEST DESCRIPTION	CONDITIONS	RESULTS				
			CELL ΔT (°C)	INPUT POWER, (watts)	HEAT REMOVED BY WATER, (watts)	HEAT LOST TO ENVIRONMENT (watts)	Q_{excess} (watts)
5	Excess heat reaction on inner diameter of nickel tubing	- Cleaned the inner diameter of the Nickel tubing with a 0.6 M K_2CO_3/6% by volume of H_2O_2 - Heated the cell to 218°C steady state - Applied 1100 psi H_2 pressure	225	640	521	103	-16
6	Low K_2CO_3 electrolyte concentration	- Reduced the concentration of the electrolyte to less than 0.1 M - 370 psi Argon over pressure applied above electrolyte - Heated the cell to 225°C steady state - Applied 1100 psi H_2 pressure	207	553	459	91	-3
7	Cell Voltage	- Applied 0.71 volts DC to Test #6 - Increased heater power to get the cell temperature up to 252°C steady state	226	623	483	105	-35
8	High Pressure Hydrogen	- Increased the H_2 pressure to 1900 psi on Test #7	236	648	526	115	-7
9	Conditioned the Nickel surface by running electrolysis	- Cooled the cell to ambient - Released H_2 pressure - Ran electrolysis for approximately 21 hours - stopped electrolysis and closed cell - 370 psi Argon overpressure applied - Heated the cell to 217°C steady state - Applied 1100 psi H_2 pressure	200	527	458	85	+16

Mean 1.7 ± 22 watts

* Test Data recorded in Thermacore Laboratory Notebook #117 pp. 1-8.

The coil was installed in the cell and tested using water cooling as described in Table 5. Six test conditions were evaluated. Each test yielded no excess heat energy above the 50 watt detection limit.

4.4.3 Coil #3: 250' of 0.125" Diameter Hard Nickel Tubing

This tubing appeared to be fairly clean coming from the factory. The only cleaning operation performed was soaking the coil in a hydrogen peroxide/potassium carbonate solution while it was installed in the cell. After cleaning, five tests were completed as recorded in Table 6 for a water cooled cell. Again, no excess heat energy was measured above the 50 watt detection limit.

4.4.4 Coil #4: 500' of 0.0625" Diameter Annealed Nickel Tubing

This coil of tubing was inserted into a second pressure vessel that was fabricated nominally the same as the first vessel. The calibration curve for this cell is shown in Figure 9. Five different tests using water cooling were conducted as described in Table 7. All of the results showed excess heat on the plus side of the energy balance. Tests 1, 3, 4 and 7 had excess heat greater than the 50 watt error limit. The average power was 57 W ± 26 W. Overall, these tests indicated the presence of excess heat, however, the water cooled cell test procedure does not permit accurate estimates.

For more accurate quantification of the amount of excess heat, we switched to testing the cell without water cooling. Seven test conditions were conducted. The results are recorded in Table 8. These tests indicated that the average amount of excess heat is 24.3 watts ± 6.4 watts.

4.4.5 Coil # 5: 500' of 0.0625" Diameter Annealed Nickel Tubing

A fifth coil was made from tubing of the same geometry as tubing used to make Coil #4, however, the tubing was wound in a way to allow venting of hydrogen as it evolves on the shell side of the coil. Figure 10 is a photograph of this coil. Vertical pieces of 0.125" diameter nickel tubing were used as spacers between wraps of 0.0625" tubing. Prior coils, such as shown in Figure 5, were tightly wound and were suspected not to readily release the hydrogen that evolves. The trapped hydrogen most likely formed a gas blanket, blocking potassium carbonate from contacting the nickel.

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TABLE 5. Test Conditions and Results for Coil #2 - 250' of Annealed Nickel Tubing*

(WATER COOLED CALIBRATION)

TEST #	TEST DESCRIPTION	CONDITIONS	RESULTS				
			CELL ΔT (°C)	INPUT POWER (watts)	WATER COOLING (watts)	HEAT LOSS TO ENVIRONMENT (watts)	Q_{excess} (watts)
1	Low K_2CO_3 Concentration	- Low K_2CO_3 concentration - 370 psi Argon over pressure - Heated the cell to 228°C steady state - Applied 1100 psi H_2 pressure	206	541	413	90.5	-37.5
2	Cell Voltage	- Applied 0.73 volts to Test #1	197	533	427	82	-24
3	Higher Pressure and Hydrogen	- Increased the hydrogen pressure to 1800 psi - Increased heater power to elevate the cell temperature to 261°C steady state	244	700	560	120	-20
4	High Concentration of K_2CO_3	- Removed the electrolyte from Test #1 and added a fresh charge of 0.6 M K_2CO_3 - Applied Argon over pressure (370 psi) - Heated the cell to 230°C steady state - Applied 1100 psi H_2 pressure	218	557	38	98	-21
5	Excess heat reaction on inner diameter of nickel tubing	- Cooled the cell to ambient - Cleaned the inner diameter of the Nickel tubing with a 0.6 M K_2CO_3/6% by volume of H_2O_2 - Heated the cell to 244°C steady state - Applied 1100 psi H_2 pressure	224	608	529	102	+23
6	Increased H_2 Pressure	- Increased the H_2 pressure to 1700 psi on Test #5	227	602	488	107	-7

Mean: -14 ± 20.7 watts

* Test Data recorded in Thermacore Laboratory Notebook #117 pp. 9-11.

TABLE 6. Test Conditions and Results for Coil #3 - 250' of Hard Nickel Tubing*

(WATER COOLED CALIBRATION)

TEST #	TEST DESCRIPTION	CONDITIONS	RESULTS				
			CELL ΔT (°C)	INPUT POWER (watts)	WATER COOLING (watts)	HEAT LOSS TO ENVIRONMENT (watts)	Q_{excess} (watts)
1	Low K_2CO_3 Concentration	- Low K_2CO_3 Concentration - 370 psi Argon over pressure - Heated the cell to 242°C steady state - Applied 1100 psi H_2 pressure at start of test	219	679	532	98	-49
2	High K_2CO_3 Concentration/Cell Voltage	- Changed electrolyte to 0.6 M concentration - 370 psi Argon over pressure - Heated the cell of 250°C steady state - Applied 1100 psi H_2 pressure.	219	669	530	98	-41
3	High K_2CO_3 Concentration	- Cleaned the coil using 0.6 M K_2CO_3, and H_2O_2 solution - Added 0.6 M K_2CO_3 Electrolyte - 370 psi Argon over pressure - Heated the cell to 24°C steady state - Applied 1100 psi H_2 pressure - Applied 0.71 volts	219	628	514	99	-15
4	Rubidium Electrolyte	- Removed electrolyte from cell and added a rubidium electrolyte. - Applied 370 psi argon over pressure - Heated the cell to 233°C steady state - Applied 1100 psi hydrogen pressure	219	664	553	99	-12
5	Removed the Argon Cover Gas	- Vented the argon over pressure from Test #5	206	597	498	90.5	-8.5

Mean: -25 W ± 18.5 W

*Test data recorded in Thermacore Laboratory Notebook #177 pp. 12-14.

TABLE 7. Test conditions and Results for Cell #2 - Coil #4: 500 Feet of 0.0625" Diameter Annealed Nickel Tubing*

TEST #	TEST DESCRIPTION	CONDITIONS	RESULTS				
			CELL ΔT (°C)	INPUT POWER (watts)	WATER COOLING (watts)	HEAT LOST TO ENVIRONMENT (watts)	Qexcess (watts)
1	LOW K₂CO₃ Concentration	- Applied 1100 psi H₂ pressure - Low K₂CO₃ concentration - Heated the cell to 240°C steady state - No gas over pressure applied to cell	229	670	653	107	+90
2	Increase H₂ Pressure	- Increased H₂ pressure to 1420 psi	211	678	632	95	+49
3	Increased H₂ Pressure	- Increased H₂ pressure to 1800 psi	223	671	624	103	+55
4	Applied Cell Voltage	- Applied 0.7 VDC to Test #3	226	671	639	104	+72
5	High K₂CO₃ Concentration	- Removed electrolyte and added 0.6 M K₂CO₃ - 1100 psi H₂ applied - Heated the cell to 230°C steady state - 0.7 VDC applied	220	671	586	102	+17
6	Increased Cell Temperature	- Increased cell temperature to 270°C	238	653	583	106	+36
7	Oxide Layer	- Vented H₂ Pressure - Purged id with air overnight while cell was 262°C - Applied 1400 psi H₂ in morning	248	657	616	120	+79

Mean: 56.8 ± 26 watts

*Test Data Recorded in Thermacore Laboratory Notebook #117; pp 16-19.

TABLE 8. Test Conditions and Results for Cell #2 - Coil #4: 500 Feet of 0.0625" Diameter Annealed Nickel Tubing (NO WATER COOLING/VACUUM IN GAS GAP)

TEST #	TEST DESCRIPTION	CONDITIONS	CELL ΔT	HEAT LOST TO ENVIRONMENT (watts)	INPUT POWER (watts)	EXCESS HEAT (watts)
1	High K_2CO_3 Concentration	- Applied 1200 psi H_2 pressure - 0.6 m K_2CO_3 concentration - Heated the cell to 294°C steady state - No gas over pressure applied to cell	276	135	120	+15
2	Increase H_2 Pressure	- Increased H_2 pressure to 2150 psi	275	134	114	+20
3	0.06m K_2CO_3	- Changed electrolyte to 0.06m K_2CO_3 - No gas over pressure - Heated cell to 291°C - Applied 2000 psig H_2	280	143	119	+24
4	Oxide	- Released hydrogen pressure from Test #3 - Purged air through tubing overnight - In morning applied 2000 psig H_2	281	144	118	+25
5	Applied N_2 Overpressure on Cell	- Cooled cell down and applied an N_2 overpressure of 350 psi to cell - Heated cell to 291°C steady state with 2000 psig applied	276	140	107	+33
6	Confirmed Cell Calibration	- Confirmed cell calibration - No H_2 applied	150 237		55 100	
7	Acid Etched Coil	- Acid etched coil in nitric acid - Rinsed with methanol then water - Added 0.6 M K_2CO_3 - Heated cell to 245°C steady state - Applied 1300 psig hydrogen	257	126	97	+29

Mean: 24.3 ± 6.4 W

*Test data recorded in Thermacore Laboratory Notebook #117 pp. 19-23.

FIGURE 10. LOOSELY WOUND DESIGN OF COIL #5
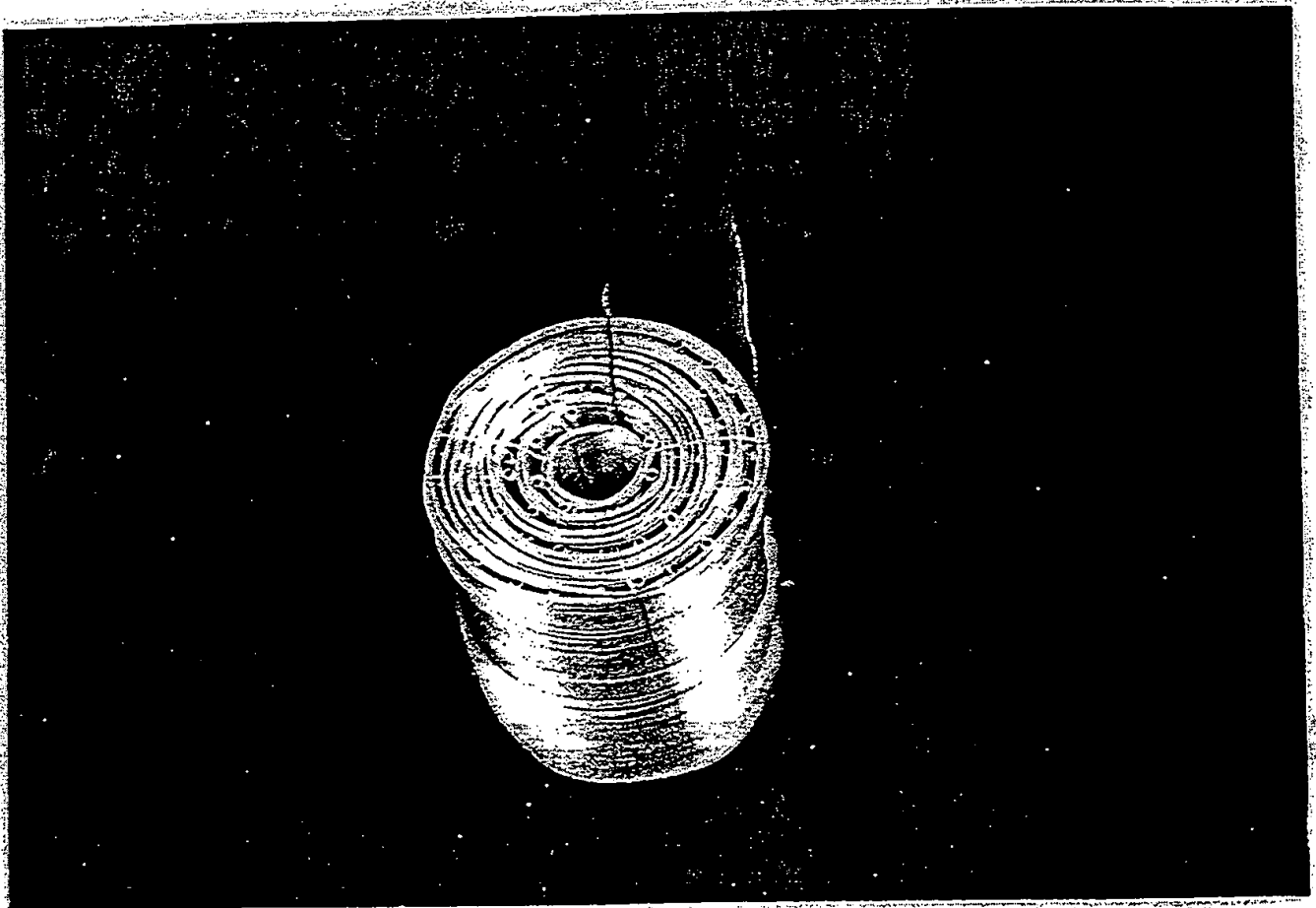
This coil was inserted in the cell and tested using the non-water cooled approach. At the present time, there is 12 watts of excess heat; this is less than the heat produced using Coil #4. Based on this result, the ventable coil design currently shows no benefit. Thermacore is continuing to test this coil on internal funding.

2.5 EVALUATION OF TEST RESULTS

The results of the testing described in Section 2.4 show the presence of about 25 watts of excess heat using Coil #4 and 12 watts of excess heat using Coil #5. This excess heat could possibly come from several sources in addition to hydrogen electronic transitions to fractional quantum energy levels claimed by Mills. The purpose of this section of the report is to evaluate the alternative explanations for the excess heat in addition to the Mills' claim.

A number of possible explanations for the excess heat have been identified during the course of this effort. These explanations are listed below:

■ Instrumentation Error: This evaluation applies to the non-water cooled testing procedure. A voltmeter, ammeter, thermocouples and associated readouts were used to measure input and output power and losses. Errors associated with one or more of these devices might explain the appearance of excess energy. These errors are estimated in the following paragraphs:

The instrumentation was calibrated using procedures meeting MIL-I-45208. The voltage ($\pm 0.1\%$) and resistance ($\pm 0.1\%$) were recorded with a digital multimeter (Fluke 8600A). The electrical heating power was calculated using the square of the voltage square divided by the heater resistance (E^2/R). Temperatures ($\pm 0.1°C$) were recorded using a Hewlett Packard Data Acquisition System and were compared to temperature measured by a microprocessor thermometer (Omega HH21) using Type K sheathed ungrounded thermocouples. Cell solution temperature was measured through a thermocouple well located at the top of the nickel coil as shown in Figure 3.

Separate independent measurements were made on a sampling basis using a different set of calibrated instruments to help identify any faulty instrumentation. These "spot checks" showed that the instrumentation operated within calibration limits. The conclusion of our review of the accuracy of the instrumentation is that power

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measurements are accurate to within about 1%. Instrumentation error does not explain the magnitude of the excess energy.

■ Gas Compression: The excess energy is initiated at the time hydrogen gas is released into the coil of nickel tubing. Analyses were done to determine if the energy released from compression of hydrogen could explain the increase in temperature observed during the experiment.

The energy generated from the compression of hydrogen is calculated in Appendix C. The results show that about 521 joules of heat are released at the time compression occurs. This 521 joules of heat are insignificant compared to the 4.5×10^7 joules of excess energy measured during the three week duration of the 25 watt experiment.

■ Exothermic Corrosion Reaction: Photomicrograph of the tubing form the #4 taken before after testing (see Figure 11) show no signs of corrosion, pitting or other chemical attach. Hence, an exothermic corrosion reaction does not explain the excess heat.

■ Hydrogen Blanketing: Hydrogen permeates through the wall of the nickel tubing and collects in the space above the potassium carbonate solution. This gas may change the heat transfer coefficient between the potassium carbonate and cover plate. A decrease in the heat transfer will result in an apparent rise in cell temperature which could falsely be attributed to the generation of excess energy.

A nitrogen cover gas is used to blanket the potassium carbonate solution at a pressure high enough to suppress boiling. This cover gas has a relatively high thermal resistance and significantly reduces heat transferred through the cover plate. Introduction of high thermal conductivity hydrogen into the cover gas serves to increase not decrease the rate of heat transfer as the experiment progresses. This increase in heat transfer will most likely result in an apparent decrease in cell temperature which could falsely be attributed to a decrease in the generation of excess heat.

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FIGURE 11. PHOTOMICROGRAPH OF THE NICKEL TUBING BEFORE AND AFTER TESTING

BEFORE TESTING

200 X LONGITUDINAL

200 X TRANSVERSE

AFTER-TESTING

200 X LONGITUDINAL

200 X TRANSVERSE

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Tests were conducted during cell calibration for purposes of establishing the effects of hydrogen accumulation in the 350 psig nitrogen cover gas. These tests show no significant change in cell steady state temperature when 350 psi in hydrogen pressure is exchanged for the nitrogen gas. Clearly accumulation of hydrogen on the shell side does not explain the excess energy.

■ Mills Theory: The electron of the hydrogen atom is predicted to transition to fractional energy levels releasing energy when contacting an energy sink resonant with the hydrogen energy released. The "ash" of the process is the "shrunken" hydrogen atom called a hydrino. Two hydrinos will react creating a dihydrino molecule forming what is reported by Mills to be an inert gas.

Lehigh University, Bethlehem, PA, has been able to detect the hydrino molecule using ESCA (Electron Spectroscopy for Chemical Analysis) absorbed on the surface of nickel cathodes used in electrolysis of K_2CO_3. This work shows a peak near 55 eV which is predicted by Mills to be the binding energy of the electron for a hydrino molecule.

ESCA analyses were also done by Lehigh University on samples of virgin nickel tubing and tubing removed from Coil #4. The results of these analyses are included in Figure 12 and show the characteristic hydrino peak at 55 eV for tubing removed from Coil #4; no peak occurs for the virgin tubing. Lehigh (Dr. A. Miller) has also seen these peaks on electrodes removed from Mills' electrolytic cells and has no other explanation for them other than being caused by the presence of hydrinos. As a result of the work done by Thermacore on this effort, we conclude that the Mills' theory is the likely explanation for the excess energy seen in the experiments done under this program.

FIGURE 12. COMPARISON OF ESCA RESULTS FOR VIRGIN TUBING COMPARED TO TUBING FROM K₂CO₃ DIFFUSION CELL
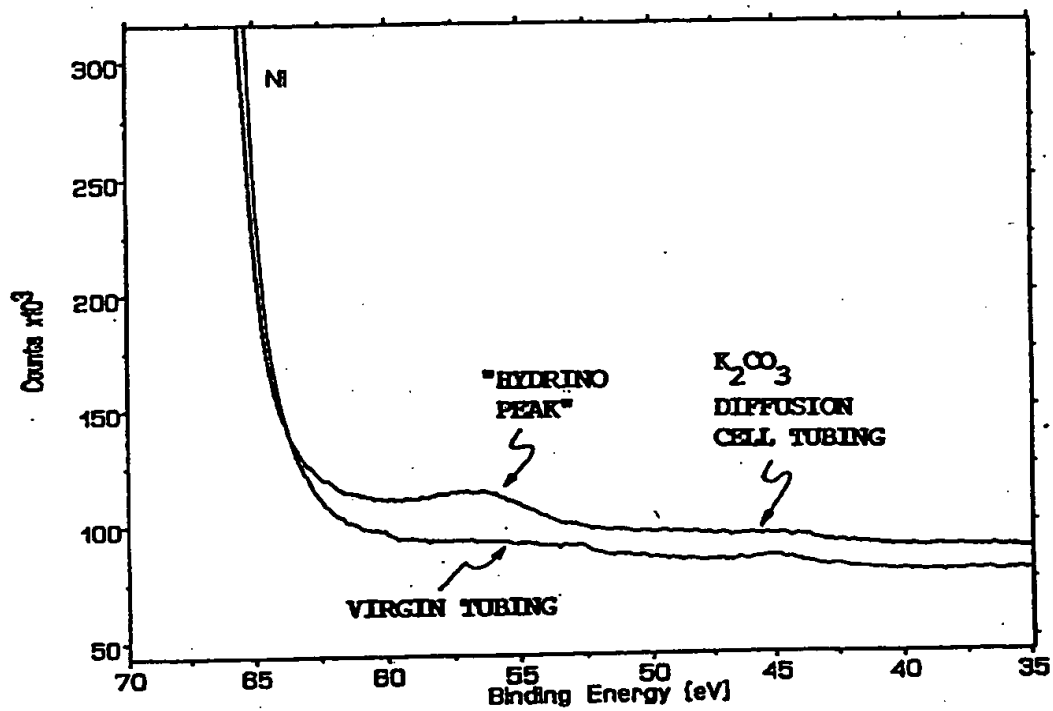
5.0 REFERENCES

1. Mills, Randell L., Kneizys, Steven P., "Excess Heat Production by the Electrolysis of an Aqueous Potassium Carbonate Electrolyte and the Implications for Cold Fusion", Fusion Technology, Vol. 20, August 1991, pp. 65-81.

2. Bush, R., "Cold Fusion with Light Water", Fusion Technology, Vol. 22 (1992), pp. 301-322.

3. Noninski, V., "Excess Heat During the Electrolysis of a Light Water Solution of Potassium Carbonate with a Nickel Cathode", Fusion Technology, 21 (1992, pp. 163-7).

4. Notoya, Reiko, "Cold Fusion by Electrolysis in a Light Water-Potassium Carbonate Solution with a Nickel Electrode", Fusion Technology, Vol. 24, September 1993, pp. 202-204.

5. Shaubach, R.M. and Gernert, N.J., "Measurements of Excess Heat from Atomic Hydrogen in Contact with Potassium Carbonate on Nickel without Electrolyses" Submitted for publication in Fusion Technology, July, 1993.

6. Mills, Randell, L., Good, William, R., Shaubach, Robert, M., "Dihydrino Molecule Identification", Fusion Technology, Vol. 25, January 1994.

7. ESCA Report, Lehigh University, Miller, Al, December 8, 1993

8. Bhattacharyya, S., Vesely, E.J. Jr., and Hill, V.L., "Determination of Hydrogen Permeability in Uncoated and Coated Superalloys Interim Report", IIT Research Institute, January, 1981.

9. Kohl, Walter H., "Materials and Techniques for Electron Tubes", Reinhold Publishing Corp., 1960, pp. 238.

APPENDIX A

HYDROGEN PERMEATION THROUGH THE NICKEL TUBING

THERMACORE, INC.

HEAT TRANSFER SPECIALISTS / ENGINEERING—MANUFACTURING

780 EDEN ROAD / LANCASTER, PENNSYLVANIA 17601

Title: Hydrogen Permeation through the nickel tubing

Calculated by: RJG   Page 1 of 3   Date 11/25/93

Approved by: _____   Date _____

Purpose: To determine the volume of hydrogen permeating into the potassium carbonate side of the cell for nickel coil #4.

Description: Coil #4 is 500 feet of 0.0625" diameter by 0.010" wall nickel 200 tubing.

Analysis: The hydrogen permeation rate through tubing is calculated using:

$$\dot{m} = \frac{2\pi L \phi \left(P_i^{1/2} - P_0^{1/2} \right)}{\ln(r_0/r_i)}$$

where,

ϕ = the coefficient of permeability, $\mu mol \, m^{-1} s^{-1} kPa^{-1/2}$

L = Length of tubing, m

P_i = input Pressure, kPA

P_0 = output Pressure, kPA

r_0 = outer radius, m

r_i = inner radius, m

Values for ϕ are determined using Figure A1.

for 200°C; $\phi \approx 6 \times 10^{-6}$ $\mu mol/m \cdot s \cdot kP^{1/2}$

$L = 152.4 \, m$

$r_0 = 0.00079 \, m$
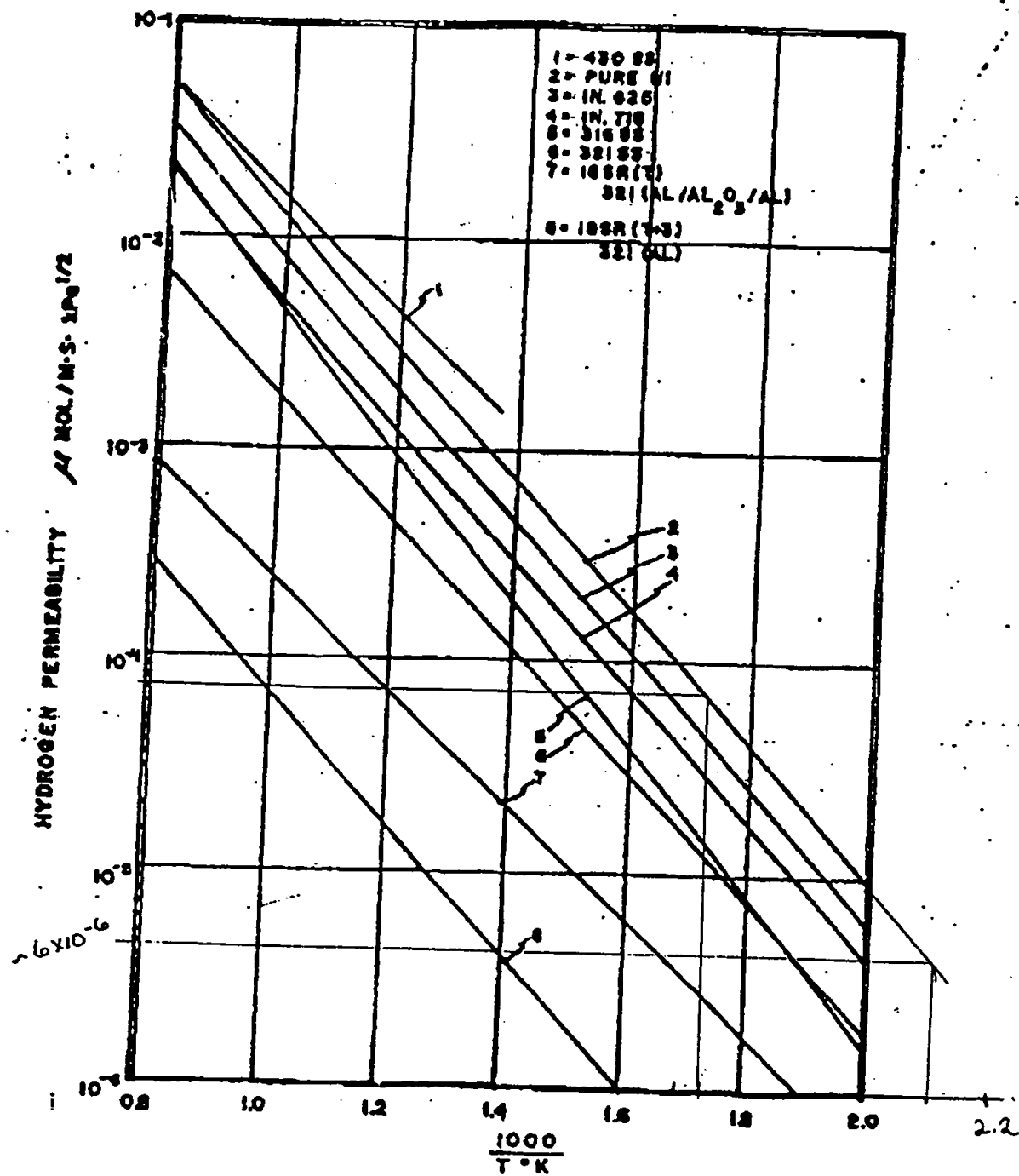
$r_i = 0.00054 \, m$

$P_i = 7584 \, kPa$ (1100 psi)

$P_0 = 0 \, kPa$

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Figure A1. PERMEABILITY RATES OF VARIOUS METALS

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Title: _____

Calculated by: _____ Date _____
Approved by: _____ Date _____

Page 3 of 3

$$\dot{m} = \frac{2\pi(152.4\,m)\,6\times10^{-6}\,\frac{\mu\,mol}{m\cdot s\cdot kPa^{1/2}}\sqrt{7584\,kPa}}{\ln 1.47}$$

$$= 1.3\,\frac{\mu\,mol}{s}\left|\frac{1\times10^{-6}\,mol}{1\,\mu\,mol}\right. = 1.3\times10^{-6}\,\frac{mol}{s}\times\frac{2\,g}{gmc}$$

$$\text{or}\quad 2.6\times10^{-6}\,g/s$$

In terms of volumetric flow rates, $\frac{cc's}{s}$

$$2.6\times10^{-6}\,g/s \div \rho_{H_2}@200\text{°}$$

$$\text{where, } \rho_{H_2}@200\text{°} = 5\times10^{-5}\,g/cc$$
$$(8.4\times10^{-5}\,g/cc @ 20\text{°}c)$$

$$\begin{array}{l}\text{Volumetric}\\\text{flow of } H_2\\@200\text{°}\end{array} = 5.2\times10^{-2}\,\frac{cc}{s}$$

$\underline{300\text{°}c}$: $\phi = 8\times10^{-5}\,\mu\,mol/m\cdot s\cdot kPa^{1/2}$

$$\dot{m} = \frac{2\pi(152.4\,m)(8\times10^{-5})\sqrt{7584\,kPa}}{\ln 1.47}$$

$$= 17\,\frac{\mu\,mol}{s}\left|\frac{1\times10^{-6}\,mol}{1\,\mu\,mol}\right. = 1.7\times10^{-5}\,\frac{mol}{s}\times 2\,g/mol$$

$$= 3.4\times10^{-5}\,g/s$$

In terms of volumetric flow rates:

$$3.4\times10^{-5}\,g/s \div \rho_{H_2}@300\text{°}$$

$$\rho_{H_2}@300\text{°} = 4.2\times10^{-5}\,g/cc$$

$$\begin{array}{l}\text{Volumetric}\\\text{flow of } H_2\end{array} = 0.8\,cc/s \quad @ 300\text{°}c$$

APPENDIX B

EXCESS HEAT FROM H_2 PERMEATING THROUGH NICKEL INTO K_2CO_3 SOLUTION

THERMACORE, INC.

HEAT TRANSFER SPECIALISTS / ENGINEERING—MANUFACTURING

780 EDEN ROAD / LANCASTER, PENNSYLVANIA 17601

Title: Estimate of the Excess Heat from H_2 Permeating through Nickel into K_2CO_3 Solution

Calculated by: NJG

Approved by: _____

Page _1_ of _2_

Date 3/14/94

Date _____

Purpose: To estimate the excess heat generated in the diffusion cell when hydrogen is "shrunk" to N = ½ and lower for Coil # 4.

Description: See Appendix A for the H_2 permeation rates through the nickel tubing as a function of temperature.

Analysis: This analysis estimates the amount of heat released assuming all the hydrogen is shrunk to N = ½ .... ⅕ using the following equation:

$$\text{Excess energy/atom} \doteq 13.6\,(n^2 - 1)\ eV \qquad \text{Eq. (1)}$$

where, n = number of quantum levels below the ground state.

$\underline{N = \frac{1}{2} @ 200°C}$

$$\frac{\text{Atoms}}{\text{sec}} \doteq 1.3 \times 10^{-6}\ \frac{mole}{s}\ (\text{from App A}) * 6.02 \times 10^{23}\ \frac{atoms}{mole} = 7.826 \times 10^{17}\ \frac{atoms}{s}$$

$$Q_{\frac{1}{2}} = 7.826 \times 10^{17}\ \frac{atoms}{s} * 40.8\ \frac{eV}{atom} * 1.6 \times 10^{-19}\ \frac{W}{eV}$$

$$Q_{\frac{1}{2}} = 5.1\ W$$

$\underline{N = \frac{1}{2} @ 300°C}$

number of atoms that permeate/second

$$\frac{\text{Atoms}}{\text{sec}} = 1.7 \times 10^{-5}\ \frac{mole}{s} * 6.02 \times 10^{23}\ \frac{atoms}{mole} = 1.0234 \times 10^{19}\ \frac{atoms}{s}$$

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Title: _____

_____

_____

Calculated by: _____ Date _____

Approved by: _____ Date _____

Page 2 of 2

$$Q_{1/2} = 1.0234 \times 10^{19} \frac{atoms}{s} * 40.8 \frac{eV}{atom} * 1.6 \times 10^{-19} \, W/eV$$

$$Q_{1/2} = 66.8 \, W$$

N = 1/3 @ 200°C

$$Q_{1/3} = 7.826 \times 10^{17} \frac{atoms}{sec} * 108.8 \frac{eV}{atom} * 1.6 \times 10^{-19} \, W/eV$$

$$= 13.6 \, W$$

N = 1/3 @ 300°C

$$Q_{1/3} = 1.0234 \times 10^{19} \frac{atoms}{sec} * 108.8 \frac{eV}{atom} * 1.6 \times 10^{-19} \, W/eV$$

$$= 178 \, W$$

N = 1/4 @ 200°C

$$Q_{1/4} = 7.826 \times 10^{17} \frac{atoms}{sec} * 204 \frac{eV}{atom} * 1.6 \times 10^{-19} \, W/eV = 25.5 \, W$$

N = 1/4 @ 300°C

$$Q_{1/4} = 1.0234 \times 10^{19} \frac{atoms}{sec} * 204 \frac{eV}{atom} * 1.6 \times 10^{-19} \, W/eV = 334 \, W$$

N = 1/5 @ 200°C

$$Q_{1/5} = 7.826 \times 10^{17} \frac{atoms}{s} * 326.4 \frac{eV}{atom} * 1.6 \times 10^{-19} \, W/eV = 41 \, W$$

N = 1/5 @ 300°C

$$Q_{1/5} = 1.0234 \times 10^{19} \frac{atom}{s} * 326.4 \frac{eV}{atom} * 1.6 \times 10^{-19} \, W/eV = 534 \, W$$

APPENDIX C

ENERGY FROM GAS COMPRESSION

THERMACORE, INC. *HEAT TRANSFER SPECIALISTS / ENGINEERING—MANUFACTURING*

780 EDEN ROAD / LANCASTER, PENNSYLVANIA 17601

Title: Energy from Gas Compression | Page 1 of 2
Calculated by: HJG | Date 3/22/93
Approved by: _____ | Date _____

Purpose: To calculate the energy generated from the compression of hydrogen and compare it to the amount of excess heat measured.

Description: The excess energy is initiated at the time hydrogen gas is released into coil #4 (500 ft of 0.0625" dia x 0.01" wall tubing)

Analysis:

Using the equation:

$$\text{Work} = PAdl = PdV = \frac{1}{2} P\Delta V$$

State 1: air at atmospheric pressure
State 2: air at 1100 psig
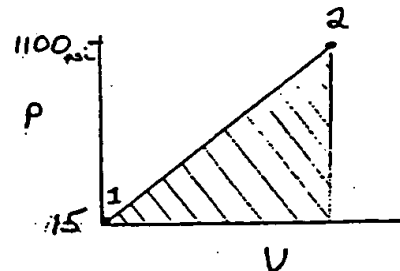
$$P_1 V_1 = P_2 V_2$$

$$\text{Work}_2 = \frac{1}{2} \left(1085 \frac{lb}{in^2}\right)(V_2 - V_1)$$

$$V_2 = \frac{\pi (.0425")^2}{4} \times 500\left(\frac{12"}{1 ft}\right)$$

$$= 8.5 \, in^3$$

$$V_1 = 8.5 \, in^3 \frac{15 \, psi}{1115 \, psi} = 0.11 \, in^3$$

$$\text{Work}_2 = \frac{1}{2}\left(1100 \frac{lb}{in^2}\right)(8.5 \, in^3 - 0.11 \, in^3)$$

$$= 4614 \, lbf \cdot in \left[\frac{4.448 N}{1 bf} \Big| \frac{2.54 cm}{1 in} \Big| \frac{1 m}{100 cm}\right]$$

$$= 521 \, N \cdot m \text{ or } 521 \, J$$

THERMACORE, INC.

HEAT TRANSFER SPECIALISTS / ENGINEERING—MANUFACTURING

780 EDEN ROAD / LANCASTER, PENNSYLVANIA 17601

Title: _____

_____ Calculated by: _____

_____ Approved by: _____

Page __2__ of __2__

Date _____

Date _____

Amount of Excess Heat Measured

$$Q_{excess} = 25 \, J/s \times 21 \, days \cdot \frac{24 \, hr}{1 \, day} \cdot \frac{60 \, min}{1 \, hr} \cdot \frac{60 \, sec}{1 \, min}$$

$$= 4.536 \times 10^7 \, J$$

Conclusion:

The 521 joules of heat from gas compression are insignificant compared to the 4.5×10^7 joules of excess energy measured during the three week duration of the 25 watt experiment.

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Department of Applied Science
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October 16, 1991

Dr. Walter Polansky
U.S. Department of Energy
Washington D.C.

Dear Dr. Polansky:

As you are aware, Dr. Noninski recently spent a week at BNL as a guest of Dr. McBreen and myself. The purpose of the visit was to demonstrate a thermo-electrochemical effect originally described by Dr. Randy Mills of Lancaster, Pennsylvania. As per your request, this is a short review of what I observed. I am not making any inference as to the impressions, observations, or conclusions drawn by Dr. McBreen.

The experiment can be briefly described as follows. A well insulated dewar was filled with a ~0.7M solution of potassium carbonate and distilled water. A nickel cathode and platinum anode were immersed in the solution along with a resistor and thermistor. The dewar was covered and became, in essence, a heat flow calorimeter. A known amount of power was applied to the resistor and the temperature of the dewar was increased until equilibrium was reached, typically 24 hours. The temperature rise in the dewar, ΔT, was divided by the power dissipated in the resistor yielding a slope with units of °C/Watt. The resistor power was terminated and the dewar was allowed to cool down. A voltage was next applied across the platinum anode and the nickel cathode. The solution was electrolyzed with hydrogen being liberated at the cathode and oxygen at the anode. The temperature of the dewar again increased and reached equilibrium after ~24 hours. The temperature of the dewar increased because some of the applied electrolysis power was dissipated in the cell. The temperature rise of the dewar, ΔT, is divided by the electrolysis power dissipated in the dewar yielding a slope with units of °C/Watt, as was done for the resistor. To correct for the evolution of gasses in the dewar the thermoneutral voltage, 1.48 Volts, was subtracted from the applied voltage, V. The electrolysis power dissipated in the dewar was obtained by multiplying the corrected voltage, V - 1.48V, by the electrolysis current.

The claim is as follows. The temperature rise in the dewar is greater in the case of electrolysis as compared to using a resistor, even though the dissipated power is equal in both cases. According to Dr. Mills' theory, this apparent "excess power" is due to the fact that the electron in a hydrogen atom can "decay" to stable subinteger quantum levels.

Dr. Noninski demonstrated this thermal effect at BNL. Before proceeding further a few comments are in order. I did not check the calibration of his equipment nor did I observe his experimental technique in great detail. The time was not available to me. There were no obvious errors and as the effect has been claimed by Dr. Mills and Dr. Noninski for some

Dr. Walter Polansky
October 16, 1991
Page Two.

time, I feel it is probably correct. What was typically observed is as follows. For a dissipated power through the resistor of 0.1 Watt a dewar temperature rise of 3°C was measured. The slope, as previously defined, was therefore 30°C/Watt. If the electrolysis power dissipated in the dewar was say 0.5 Watts, a temperature rise of 3°C was observed giving a slope of 60°C/Watt. The question is, why does the power dissipated in the dewar, when applied electrolytically, give a larger temperature rise as compared to a resistor? One possibility is that the evolving gasses are recombining in the dewar. Dr. Noninski checked this by measuring the Faraday efficiency of the electrolysis in a separate experiment. There appeared to be little gaseous recombination. I must emphasize that the quantity of gasses evolving from the dewar were not measured. Gaseous recombination in the dewar was not, therefore, unequivocally ruled out. Another possibility is that there is a chemical reaction occurring. For example can potassium carbonate be catalytically decomposed into say potassium hydroxide? Finally, the process of electrolysis infuses the solution with fine bubbles. These bubbles would be expected to change the thermal characteristics of the calorimeter. I discussed this with Dr. Noninski and he produced some experimental results from the literature indicating that the bubbles should have decreased the measured value of the slope and not increase it (as compared to a resistor).

        In summary, there appears to be an unusual thermal effect (at very low power levels) which occurs during the electrolysis of potassium carbonate solutions. The presence of "excess power" has not, however, been demonstrated much less "proved". A number of basic experiments need to be performed to eliminate some of the possibilities previously outlined. Finally, there are probably many other possible explanations for explaining this thermal anomaly and these would, of course, also need to be investigated.

                                        Sincerely,

                                        Harold Wickmann
                                        Materials Science Division

HW/mal

In re Application of

MILLS

Appl. No. 07/825, 845

Filed:

For: ENERGY/MATTER CONVERSION
METHODS AND STRUCTURES

_____

The Hon.Commissioner of Patents
        and Trademarks
Washington, DC 20231

Sir:

Sergei B.Nesterov, residing at 4-12 Remizova st. Moscow, Russia, 113186 declares and states that:

1.I received a Bachelor of Science degree in cryophysics engineering (physics and technology of low temperatures) , Moscow Power Engineering Institute (MPEI), 1980.

2.In 1980-81 I worked as an engineer at Cryogenics Department MPEI, participating in development of elements of the thermal management of space crafts a) heat pipes; b) thermal radiator.

3. PhD degree in nuclear fusion products pumping, MPEI, 1985. Since 1989 I am an associate professor at MPEI Cryogenics Department.

4. In 1982-88 I participated in developing of systems of fusion reaction products pumping and regeneration.

5. I am currently the Head of MPEI Cryogenics Center and the senior manager responsible for creating a model of pumping block of nuclear fusion products for ITER project (International Thermonuclear Engineering Reactor).

My current work includes also development of technology for protective coverings, creation of highly effective systems for purification of sewage.

6. I am the author and co-author of numerous technical reports and papers, of which selected publications are shown in the attachment.

Alexei   P.Kryukov,   residing   at   11/2-63 Sadovaya-Chernogryazskaya st., Moscow, Russia 103064 declares and states that:

1. I received a Bachelor of Science degree in industrial heat power from MPEI in 1972.

2. I received a PhD degree in heat transfer, MPEI, 1977.

   Postdoctorial - DSc(Eng) - MPEI, 1990 , Moleoular Physics.

3. I am currently a Professor in Cryogenics Department, MPEI, and also a senior scientist in fundamental research of transport processes on the interphase gas-condensate.

4. In 1976-79 together with Professor Labuntsov (MPEI) we developed an approximate method of strong evaporation and

condensation analysis. Based on the principles of the molecular kinetic theory, simple formulae were suggested for engineering practice. These formulae are valid at subsonic vapour velocities. A comparison of the calculation results with the experimental data of Niknejad and Rose (see: Niknejad J. and Rose J.W. in Proc.Royal Soc.London.1981 Vol.378.P.305-327; Kosasie A.K. and Rose in Proc. 7-th ASME National Heat Transfer Conference San-Diego, USA, 1992) on strong condensation of mercury showed a good agreement. In 1986 Pong L. and Moses G.A. generalized method used by Dr. Labun t sov and me to the problem of strong condensation in the presence of a noncondensable gas (see: Pong L. and Moses G.A. in Phys.Fluids. 1986.Vol.29.No.6P.1796- 1804).

In 1987 an accurate analysis of heat-mass transfer on vapour-liquid interphase at the reflection of sound wave on this surface was made by me and Dr.Labuntsov. It was shown that for liquid metal and superfluid helium the sound reflection coefficient was very small. As a result a large part of sound energy incoming to interphase was converted into heat on this surface.

In 1983-1991 I studied the processes of evaporation and condensation on the base of the Boltzmann equation solutions. Some theoretical results for supersonic condensation were confirmed by my own experimental data at cryogenic temperatures.

5. My previous work includes research and development of cryovacuum means for helium and hydrogen isotopes pumping. I also studied processes of heat transfer in superfluid helium. As a co-author of Steve Van Sciver (USA) I theoretically received a value of the recovery heat flux from boiling in superfluid helium

6. I am the author and co-author of numerous scientific papers and technical reports, of which selected publications are shown in the attachment.

Sergei B.Nesterov and Alexei P.Kryukov together declare and state that:

1. We have reviewed and understand the concept covered by the subject U.S. application No.07/825,845 of Dr.Randell L.Mills and we are personally familiar with the methods and apparatus disclosed therein.

2. We (hereinafter MPEI) have conducted independent experiments on nominally identical apparatus to that made by Dr. Randell Mills (hereinafter HPC) to check HPC's method and results, since July of 1992.

3. MPEI's experiments show 0.75 watts of heat output with only 0.3 watts of heat input. Excess energy on the order of 0.45 watts has been produced reliably and continuously over the last three months. Scintillation counter measurments show no signs of radiation external to the cell.

DESCRIPTION OF THE MPEI CELL

The MPEI experimental cells were assembled comprising a 1000 ml silvered vacuum jacketed dewar with a 10 cm opening. The cathode was a 7.5 cm wide by 5 cm long by 0.125 mm thick nickel foil (Aldrich 99.9 %, cold roll, clean Ni) spiral of 9 mm diameter

by tightly ⬤⬤ the nickel foil abou⬤⬤ mm rod. The rod was removed. The leads were inserted into glass tubes to insure that no recombination of the evolving gases occurred. The anode was a platinized titanium (Engelhard Pt/Ti mesh 2 by 2 inches) covered with 100 μ platinum series 3000). The cathode and anode cables were connected to terminals bolted to the cell lid. The lid was made of resin glass. A foam plastic disk was set under the lid to lessen heat losses. The disk was 1 cm thick covered by film foil. See Figure 1.

Before assembly, the anode array was cleaned in 3 M HCl for 5 minutes and rinsed with distilled water. The cathode was rinsed with distilled water.

The electrolyte solution comprised 1 liter of 0.57 M K2CO3 (Alfa K2CO3 98%).

The heater comprised a 6.6 ohm Nichrome wire. It was inserted into the glass jacket and suspended with Teflon covered leads.

It was powered by an Invar constant power (± 0.1%) supply (Model Б-5-49). The heater resistence was measured by means of calibration resistor. The current (± 0.1%) was recorded with amperemeter M 903. The electrolysis current (± 0.1%) was measured by amperemeter M 903.

The temperature (± 0.1°C) was recorded with a microcomputer thermometer (MΓEI). To provide tempetature control copper constantan thermocouples were used.

The temperature (ΔT = T (electrolysis only)- T (ambient)) and the electrolysis power were recorded regularly. The heating coefficient was determined "on the fly" by the addition of heater power at 72 hour increments where 24 hours were allowed for steady state to be achieved. The temperature ΔT2 = T(electrolysis + heater)- T (ambient) was recorded as well as the electrolysis power. The ambient temperature was measured from a

blank cell that comprised a closed liter silvered vacuum jacketed dewar containing 1 liter of H_2O placed near the electrolysis cell.

The electrolyte solution was stirred by a 0.7 cm open prolate spheroid magnetic stirring bar which was spun by a mixing motor made in Czechoslovakia.

Figure 2 shows the electrolysis cell on test.

RESULTS

A heat balance of the cell is shown in Figure 3; some of MPEI results are shown in Table 1. From Table 1 it is clear that by growth of electrolyte temperature due to the increase of load of the additional heater electrolysis current grows at constant voltage of 3 V. Calculation method for 0.45 watts of excess power is represented graphically in Figure 4.

The theory that led to the discovery of this electrolytic process was developed by Dr. Randell Mills, HPC, Lancaster, Pennsylvania. This theory is covered by a patent application entitled "Energy/Matter Conversion Methods and Structure", and is described in the Fusion Technology article "Excess Heat Production by the Electrolysis of an Aqueous Potassium Carbonate Electrolyte and the Implications for Cold Fusion" by Dr.Mills and S.Kneizys, the article entitled "A Unified Theory Derived from First Principles" (submitted to the Physical Review for publication by Dr.Mills and W.Good), the article entitled "Two Electron Atoms and Elastic Electron Scattering by Helium" (submitted to Physical Review for publication by Dr.Mills) and the books entitled "The Grand Unified Theory", by Dr.Mills and Dr.J.Farrell, "Unification of spacetime, the forces, matter and energy" by R.Mills.

Under the Mi⬤⬤ory the predominant ⬤⬤ of heat is believed to be an electrocatalytically induced reaction whereby hydrogen atoms undergo transitions to quantized energy levels of lower energy than the conventional "ground state". These lower energy states correspond to fractional quantum numbers. The hydrogen electronic transition requires the presence of an energy hole of approximately 27.2 eV provided by electrocatalytic reactant(s) (such as $PD^{2+}/Li+$, Ti^{2+}, or $K+/K+$), and results in "shrunken atoms" analogous to muonic atoms. Calorimetry of continuous electrolysis of aqueous potassium carbonate (K+/K+ electrocatalytic couple) at a nickel cathode was performed in the calorimetry cells. Total power out exceeded total input power by a factor of 2.5 as described, above.

MPEI tests results are summarized as follows:

1. Evaluation of the electrolyte after three months operation shows no significant change in its density and molar concentration.

2. The cell was diaassembled and inspected after over one month of operation at 0.1 amper. This inspection showed no visible signs of a reaction between the electrodes and electrolyte. The cell was re-assembled and is operating as before, producing excess heat for three months.

3. Measurements of neutrons were not considered necessary since light water is used in place of deuterium. A scintillation counter was placed next to the cell. No radiation levels above background were detected indicating that nuclear reactions are not involved.

4. Water makeup rates match the Faraday usage plus evaporation.

We declare further that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements

and the like ⬤⬤ made are punishable by ⬤⬤ or imprisonment, or both, under Section 1001 or Title 18 of the United States Code and that such willful false statements may jeopardize validity of the application or any patent issuing thereon.
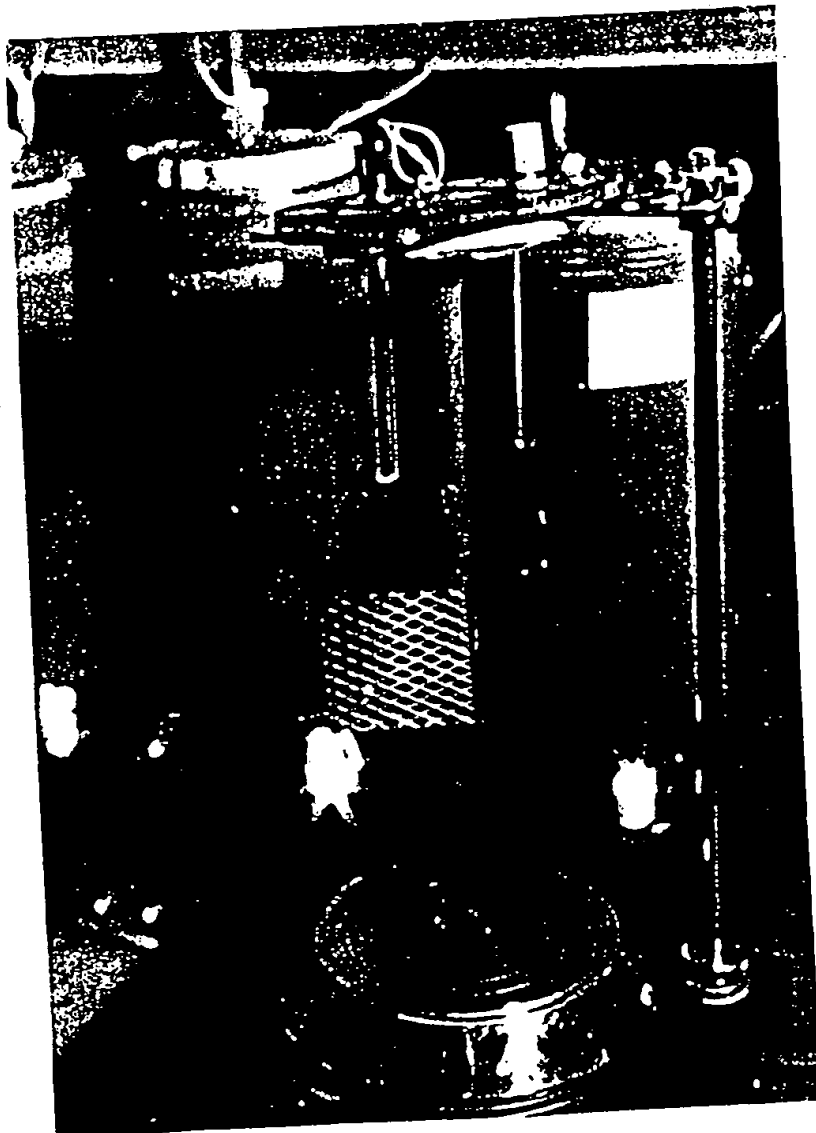
Figure 1. CELL ASSEMBLY
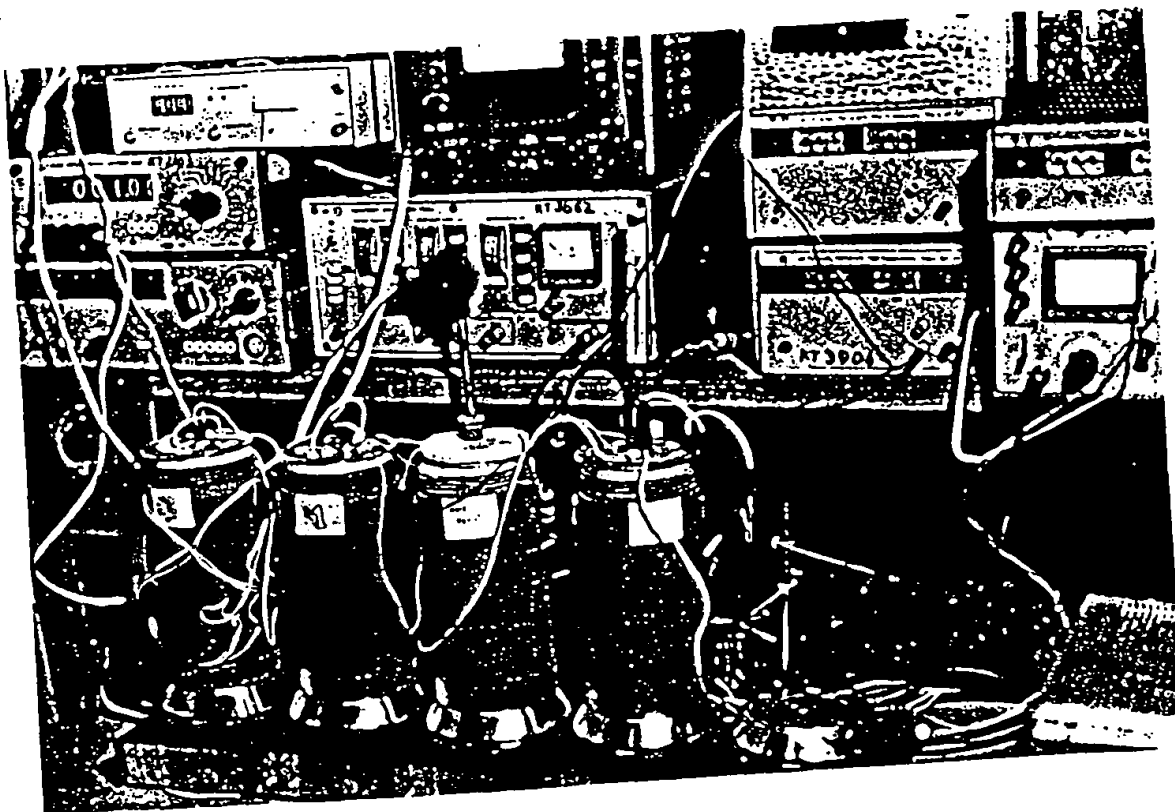
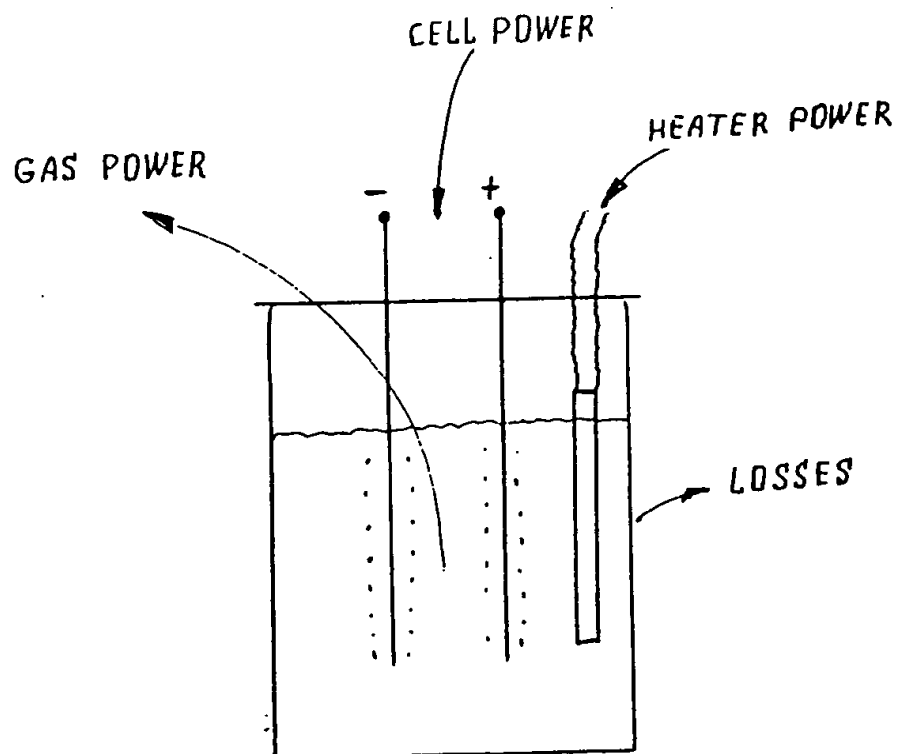Figure 2. ELECTROLYTIC CELLS ON TEST

Figure 3. CELL HEAT BALANCE

cell power = VI

gas power = 1.48 I

ohmic power = (V-1.48) I

heater power = $V_H I_H$

losses - measured incrementally
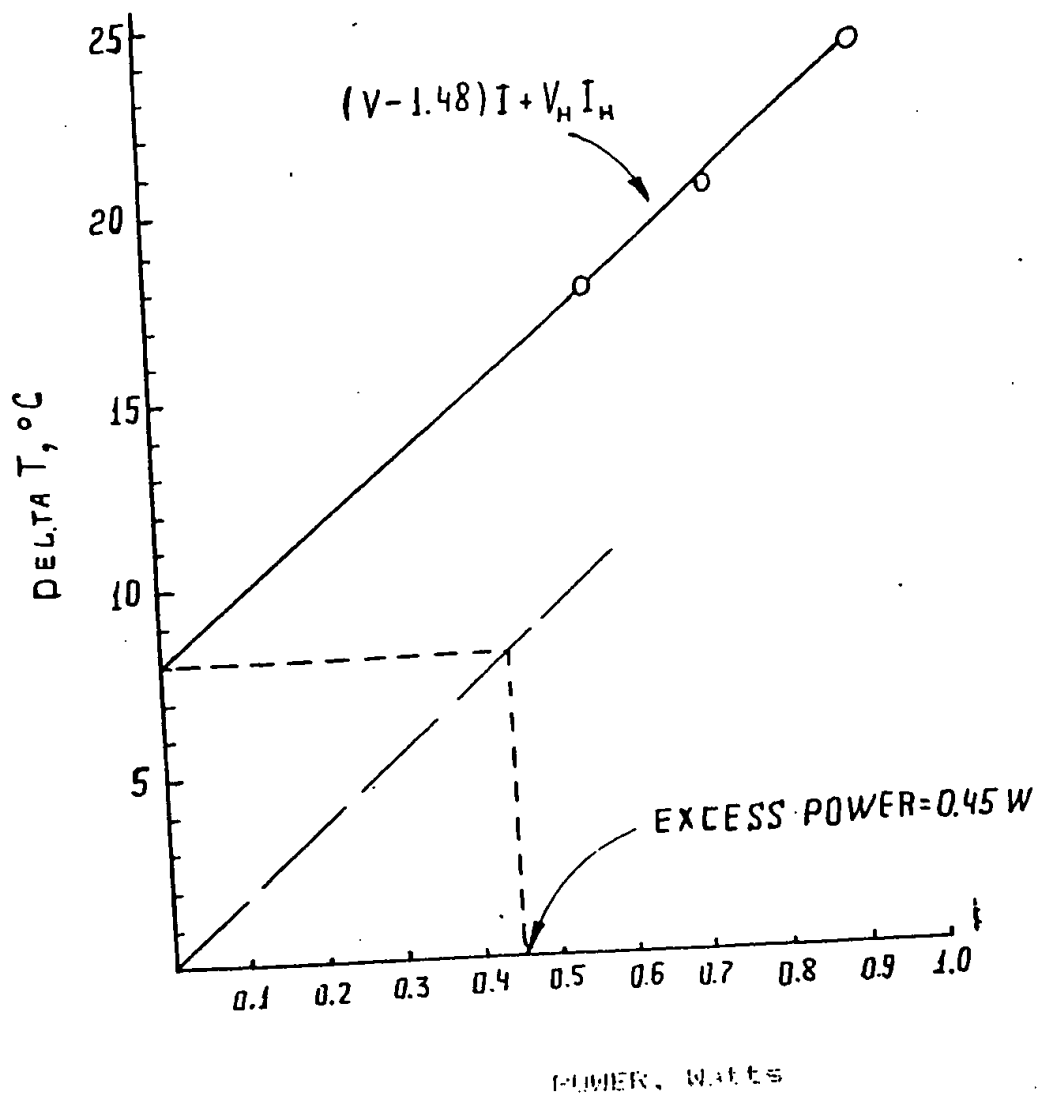
Figure 4. METHOD FOR CALCULATING

EXCESS POWER

$(V - 1.48)I + V_H I_H$

EXCESS POWER = 0.45 W

DELTA T, °C

POWER, watts

TABLE 1. Summary of MPEI Test Results

Input Conditions			Output Conditions				Output / Input
V (Volts)	A (Amps)	Total Input Power=VI (Watts)	Total Output Power (Watts)	Subcomponents(Watts)			
				Gas 1.48I	Excess	Ohmic Heating = $(V-1.48)I$	
3.00	0.100	0.300	0.750	0.148	0.450	0.152	2.50
3.00	0.107	0.321	0.771	0.158	0.450	0.163	2.40
3.00	0.121	0.363	0.813	0.179	0.450	0.184	2.24

ATTACHMENT

Sergei B.Nesterov

Head of MPEI Cryogenics Center

Kryukov A.P. and Nesterov S.B. Investigation of helium cryosorption on layers of condensed argon. Book: Proceed. of III All-Union Conf. on Engineering Problems of Fusion Reactors: M.:TSNII-atominform, 4, 1984.

Kryukov A.P., Nesterov S.B., Sidorov E.V. Helium cryosorption by layers of condensed gases. VANT, series Thermonuclear Fusion, 1, 1986.

Koresheva E.R, Kryukov A.P., Nesterov S.B., Nikitenko A.I. Dependence of sorptional properties of argon and nitrogen cryolayers on formation conditions. Soviet Physics – Lebedev Institute Reports. Allerton Press, Inc., N.Y.10011. Vol.1. 1987.

Nesterov S.B. Untersuchungen zum Prozess der Kryosorption von 4He. 17 Symposium Tieftemperatur-Physik und Tieftemperatur-Technik, Dresden, 1988.

Gurevich L.S., Nesterov S.B., Kryukov A.P. and Bichkov A.I. Helium cryosorption at temperature lower tnan 4.2 K. Plasma devices and Operations, 1, 1991.

Nesterov S.B., Kryukov A.P. Helium and hydrogen pumping by layers of condensed gases. Vacuum Science and Physics, 1, 1992.

book: Gurevich L.S., Kryukov A.P., Nesterov S.B. and Saksaganski G.L. Cryosorptional devices of vacuum pumping. Moscow, 1991.

Kryukov A.P.

Professor of MPEI Cryogenics Department

Labuntsov D.A., Kryukov A.P. Analysis of intensive evaporation and condensation. Int.J. Heat Mass Transfer, 22, 1979.

Kryukov A.P., Van Scriver S.W. Calculation of the recovery heat flux from film boiling in superfluid helium. Cryogenics, 9, 1981.

Kryukov A.P., Mlynsky A.V., Voronin A.V., Shishkova I.N., Cheremissine F.G. Creation of cryovacuum systems on the base of simulation in rarefied gases. Proc. 4-th Int. Conf. on Computational Methods and Experimental Measuremennts, Computers and Experiments in Mechanics, Capri, Italy, 1989.

Kryukov A.P., Kolesnikov N.V. Some ways of film condensation intensification. Proc. 2-nd Int.Symp. on Condensers and Condensation, Univ. of Bath, U.K., 1990.

Kryukov A.P. Strong subsonic and supersonic condensation on a plane surface. Proc. 17-th Int. Symp. on Rarefied Gas Dynamics, ed.by A.E. Beylich (VCH, Weinheim), 1991.

Kryukov A.P. One-dimensional steady condensation at vapour velocities comparable with sound velocity. Izv. AN USSR. Mech.Fluid and Gas, 3, 1985.

Labuntsov D.A., Kryukov A.P. Reflection of sound from free surface of liquid. Teplofiz. Vys.Temp., 25, 1987.

Kryukov A.P. The influence of condensation coefficient on the vapour flow at condensation with sub- and supersonic velocities. Izv. AN USSR, Mech. Fluid and Gas, 2, 1988.

Kryukov A.P., Mlynsky A.V. Investigation of nitrogen condensation process in molecular-viscous regime. ZPMTF /English Translation: J.Appl.Mech. and Techn. Phys./4, 1988.

Kryukov A.P., Dubovitsky Y.A., Mlynsky A.V. Experimenta determination of sticking coefficients of helium on desublimate gases at low temperatures. Poverhnost, 10, 1989.

Aristov V.V., Kryukov A.P., Cheremissine F.G., Shishkova I.N. Th Boltzmann equation solving for the plane jet flows wit condensation on a cryopanel. Zh.Vych. i Mat. Fiz., vol.31, No.7 1991.

textbook: Labuntsov D.A., Yagov V.V., Kryukov A.P. Fundamentals of Two-Phase Systems Mechanics. Moscow Powe Engineering Institute, 1988.

By: _____

Sergei B.Nesterov

Date: _2 / 26 / 93_

By: _____

Alexei P.Kryukov

Date: _2/26/93_

USA EMBASSY, MOSCOW

On this, the 26th day of February, 1993, before me a notary public, the undersigned officer, personally appeared Sergei B.Nesterov and Alexei P.Kryukov, known to me (or satisfactorily proven) to be the persons whose names are subscribed to the within instrument, and acknowledged that they executed the same for the purposes therein contained.

In witness whereof, I hereunto set my hand and official seal.

_____

Notary Public

THOMAS J. HUSHEK
Vice Consul of the United
States of America

Russian Federation . . . .
Moscow Oblast . . . .
City of Moscow . . . .
Embassy of the United States of America
Consular Section . . . .

LEHIGH X-RAY PHOTOELECTRON SPECTROSCOPY REPORT

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During the past five months a series of XPS analyses have been carried out on 1) Ni electrodes that have been used for hydrolysis experiments, 2) various standards and 3) precursor electrode material. The results of these measurements are presented in this report.

Experimental

The instrument conditions were similar, but not necessarily identical, for all the analyses. However, in all cases, a high quality spectrum was obtained over a minimum binding energy range of 80 to 0 eV. This completely covers the Ni 3p region and the region around 55 eV which is the approximate location of a n=1/2 to infinity transition of reduced energy state hydrogen. In many of the spectra, many other regions were also scanned. The specific regions depended upon the elements observed in a survey spectrum.

The first step in the analysis of electrodes from cells running at Lehigh consisted of removing the electrode from the cell while maintaining the electrode overvoltage during the removal. Immediately after disconnecting the electrode for the power supply, it was rinsed with distilled water and dried with an N_2 stream. A piece of suitable size was cut from the electrode, mounted on a sample stub and placed in the vacuum system. This procedure typically required 10 to 15 min. If the electrodes were from cells not running at Lehigh, the analyses were carried out on "as

received" material without any additional surface preparation. Wire specimens were mounted such that the wire extended over the edge of the sample holder. This was done to eliminate any possible contributions to the spectrum from the sample holder material.

The preparation conditions and experimental conditions for the various samples are summarized below. The details of the cleaning, electrolyte preparation, etc. are recorded in Dr. Mills notebooks. These descriptions are intended to provide a quick identification only. Samples #1 to #9 were run using K_2CO_3 electrolytes. Samples #10 to #14 were run with Na_2CO_3 electrolytes.

Sample #1: Nickel foil was cleaned at Lehigh according to the standard procedure in place at the end of June, 1993. The K_2CO_3 electrolyte was from the original batch used for earlier HPC experiments. A platinum counter electrode was used in this experiment. The cell was run for approximately 48 h from 6/24/93 to 6/26/93 prior to the analysis.

Sample #2: The preparation for this sample was nearly identical to that for sample #1. The major difference was the use of higher purity K_2CO_3 . This cell ran for about 50 h from 6/30/93 to 7/2/93.

Sample #3: A freshly prepared electrode was placed in the solution used for sample #1, and the cell was operated for about 50 h from 6/30/93 to 7/2/93.

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Sample #4: This is a re-analysis of sample #1 after sitting in a plastic bag for 26 days.

Sample #5: This is a re-analysis of sample #3 after sitting in a plastic bag for 26 days. A different portion of the electrode was analyzed.

Sample #6: Electrode material from a cell a HPC. The electrode was delivered on ice from HPC.

Sample #7: Nickel wire electrode with an extended running time at Lehigh of about 42 days.

Sample #8: Electrode material from a Ni-Ni cell that had been operating at Lehigh for 8 days.

Sample #9 Wire electrode removed on 10/1/93 from an HPC cell for which heat data is available. The sample was delivered under LN_2 by Bill Goode.

Sample #10 was taken from one of the two initial cells used for the first experiments at Lehigh.

Sample #11 was prepared using the same electrolyte and dewar that were used for sample #10. This cell was run for several weeks before the electrode was analyzed.

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Sample #12 was obtained from a cell in which a small amount of ZnSO$_4$ had been added to the electrolyte.

Sample #13 was from a cell that had been running at HPC for an extended period of time. It was brought to Lehigh on ice and kept below freezing prior to being placed in the vacuum system.

Sample #14 was Ni wire taken from a control cell at HPC. It is the exact analog of Sample #9 except for the difference in electrolyte. Thermal data is available for this sample.

Specimens of pure elements and the passivation oxides of these elements that were analyzed to provide standards are not given sample numbers. The preparation conditions for these specimens are listed on the figures or given in the figure captions.

Results - K$_2$CO$_3$ electrolyte samples and standard materials

A survey spectrum of sample #1 is shown in Fig 1. The primary elements are identified on the figure. Most of the unidentified peaks are secondary peaks or loss features associated with the primary elements. The detector was saturated in the high binding energy portion of the spectrum, which has the effect of flattening the peaks in this region and distorting their intensities relative to the peaks in the lower binding energy portion of the spectrum. Though this distortion tends to overemphasize the Sn component, it

still clear that Sn is a major component of the surface composition. It is the presence of Sn and/or other contaminant elements in many of the spectra that has obscured and complicated the interpretation of the data.

Figures 2 shows the low binding energy range for the specimen. The data were accumulated over many hours to yield this level of signal-to-noise without smoothing. The peaks which can be positively identified are labelled in the figure. The broad peak labelled X is the one of most interest because it falls near the predicted binding energy for a hydrino transition. It has a FWHM of about 5.1 eV, and it is centered at a binding energy of 54.6 eV. (It is important to note that binding energies in XPS are measured relative to the Fermi level, and not to the vacuum level.) However, it is necessary to eliminate all other possible explanations for this peak before it can be positively identified as resulting from a reduced energy state hydrogen atom. For example, the Pt $5p_{3/2}$ falls at an energy of 51.4 eV, which is close to the predicted energy of 54.4 eV, and Pt can clearly be identified as a surface component from the Pt 4f peaks at 74.29 and 70.95 eV. From a spectrum of pure Pt, it was determined that the area ratio of the Pt $5p_{3/2}$ peak to the total Pt 4f peak is 0.043, whereas, in the spectrum the area ratio of X to the Pt 4f peaks is 0.75. Thus, the area of X is about 17 times too large to attribute the peak to Pt. Other possible explanations that must be considered are fine structure or loss features associated with

either of the three major surface components, Ni (oxide), Sn (oxide), Zn (oxide) or small amounts of other elements which have their primary photoelectron peaks in the vicinity of 55 eV.

To examine these possibilities, several experiments were carried out. Figure 3 shows expanded scale spectra of Ni electrode foil material that has undergone a variety of treatments ranging from clean metal (scraped in vacuum) to room temperature oxidation in pure O_2 (oxidized at 30 kPa for 15 min at r.t.) to air passivation at room temperature (scraped in air immediately before insertion into the vacuum system). Examination of Figure 3 shows no evidence for any spectral features in the 65 to 45 eV energy range that can be associated with either Ni or its oxides for the experimental conditions that were explored. It seems unlikely that further oxidation or hydration of the oxide layer would result in the growth of any spectral features in this energy range.

The question of both Sn and Pt as the source of the peak is addressed by Figure 4. The Pt $5p_{3/2}$ shown in the bottom curve is disproportionately large for the actual size of the Pt 4f peaks in the spectrum. The overemphasis is being used to show that the peak position does not match that of the known feature. The other two spectra are of clean Sn metal and a thick Sn oxide. Clean Sn metal has a bulk plasmon peak at about 53 eV. However, this peak is several times weaker than the plasmon at 38.7 eV. The 38.7 eV peak does not appear in the spectrum from Sample #1. Therefore, the

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unknown peak cannot be ascribed to Sn metal. The thick Sn oxide shows no structure in the energy range from 65 to 30 eV. A comparison of the Sn peaks from sample #1 and the Sn oxide indicate that most of the Sn signal in the sample #1 spectrum is from oxidized Sn. Zinc also appears in the survey spectrum. Comparisons between Sample #1 and Zn metal and oxide are shown in Figs 5 and 6. The arguments for discounting a Zn contribution are the same as those used to eliminate Sn the source of the feature.

With the exception of Li, there are no other common elements with a primary photoelectron peak at about 55 eV. Looking to other elements with secondary peaks at this position, the most probable candidate is the Fe 3p. The primary Fe peak, the 2p levels, are obscured by the very strong Ni Auger lines which overlap Fe 2p energy range. This possibility cannot be completely eliminated without further study, though spectral synthesis using spectra from clean Fe and clean Ni suggest that Fe concentrations of <5% relative to Ni should be discernible in the Fe 2p energy region.

Additional sets of data were obtained from Sample #1. One set of data were obtained after the specimen was heated to about 700 C. Another set of data were obtained after the electrode had been stored in air for 26 days. This was identified as Sample #4 in the experimental section. The comparisons are shown in Figure 7. Using the Mg 2p as a marker peak, it will be noted that the shape of the

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feature changes upon heating and that the centroid shifts to a higher binding energy. The binding energy of the feature has also shifted to higher values in the spectrum of the stored specimen. The reasons for these changes are not obvious, especially for the heated specimen. Heating under UHV conditions tends to reduce oxides. Normally this results in peaks shifting to lower rather than higher binding energies. This is evident in Figure 8 which shows the Sn 4d spectrum of Sample #1 before and after heating. Also shown for comparison are spectra from a thick Sn oxide and Sn metal. Heating did not completely reduce the oxide, but the spectra show that it is more metallic than oxidized after the heating. The amount of Ni oxide was also reduced as a result of the heating. If the feature is an Fe 3p peak, the expected result would be a decrease in the binding energy upon heating rather than an increase.

In summary, the spectrum from Sample #1 yields a broad feature centered at about 55.4 eV. Most contaminant elements have been eliminated as the source of this feature, though the slight possibility remains that it is an Fe 3p peak or a very unusual contaminant. The feature undergoes slight changes in shape and shifts to slightly higher binding energies as a result of both heating and storage.

A survey spectrum from Sample #2, which was prepared using a higher purity K_2CO_3 , is shown in Fig. 9. The amount of Sn is much lower

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in this spectrum, though there are substantial amounts of Zn and Ti. An expanded spectrum of the lower binding energy range is shown in Figure 10. Many of the peaks are labelled. A further expansion and comparison is shown in Figure 11. It can be noted that the unknown feature is also present in this sample as well, though it is at a slightly higher binding energy.

A comparison of the lower binding energy region for Samples #2 and #3 is shown in Figure 12. There are two significant differences: 1) Sample #3 has a high concentration of Pt on the surface from the counter electrode and 2) there is no Ti and much less Zn on Sample #3. Both samples have very low Sn concentrations. Figure 13 shows a further expansion of the spectra together with a portion of a clean Pt spectrum. The feature at about 52 eV in the curve from Sample #3 is clearly the Pt $5p_{3/2}$ photoelectron peak.

As indicated previously, Sample #4 is a reanalysis of Sample #1. The results from Sample #4 were discussed above to some extent. The only additional comment about Sample #4 is that the data show that the nickel oxide layer had thickened during the storage time.

Sample #5 was a reanalysis of sample #3. Spectra for Sample #5 are shown in Fig. 14. As expected, the spectra from both samples are very similar. The differences in composition can probably be attributed to sampling from different regions on the electrode. The feature at 52 eV can be attributed to the Pt concentration.

The low binding energy region of Sample #5 and a comparison with Sample #3 and Ni metal are shown in Fig. 14.

Sample #5 is very similar to sample #3 in that it used the initial electrolyte with a new electrode.

The spectrum in Fig. 15 is from Sample #6. It is a cathode that was run for an extended period of time at HPC and was delivered on ice. The surface is quite heavily covered with hydrocarbon. In addition, a number of other elements are observed on the surface including Ca, Nb, Si and Pt. As can be seen from Fig. 16, any information about the feature at 55 eV is hidden by the amount of Pt and other elements on the surface.

Figure 17 shows the survey spectrum of a wire cathode that was run for a very long time at Lehigh. In addition to the elements listed on the figure, there were also a small amounts of Ti and Mg on the surface. Figure 18 shows expanded views of the low binding energy region. The unknown feature is quite strong in the spectrum from Sample #7. Comparisons of the spectrum from Sample #7 and Sample #1 are also provided. It can be noted that the position is slightly different, but it is clearly the same feature.

The spectra from the Ni-Ni cell are shown in Figs. 19 and 20. In addition to the expected Ni and O, there are significant amounts of Te, In and Pb. The Te appears to mostly metallic. Both Pb and In

have oxide and metallic components. There is no strong evidence for a feature around 55 eV.

The final specimen of Ni in a K_2CO_3 electrolyte was Sample #9 which came from a cell at HPC. The is heat data available for this specimen. The survey spectrum in Fig. 21 shows that the only significant contaminant is In. There is also some K, which suggests that the rinsing may not have been complete. There is also a trace of Si. Figure 22 provides the expanded views of the lower binding energy regions. The center of the feature is closer to 57 eV than it is to 55 eV, but it is still very similar in shape to the features in the other spectra.

Of the seven different samples using the K_2CO_3 electrolyte (Samples #1 and #4 were the same, as were Samples #3 and #5), four showed evidence of a feature at about the correct binding energy for a transition involving a factional energy level hydrogen atom. These were Samples #1, #2, #7, and #9.

Results - Na_2CO_3 electrolytes

The spectra for Sample #10 are shown in Figs. 23 and 24. The various elements detected on the surface are labelled on the figures. It was impossible to assess the possibility for a feature or lack thereof because of the very large amount of Mg that plated out during the electrolysis.

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The results for Sample #11 are shown in Figs. 25 and 26. A large amount of Pt had plated out on the surface during this experiment, and the Pt $5p_{3/2}$ peak interferes with any small features that might be at lower binding energy.

Sample #12 was from the experiment in which a small amount of Zn salt was added to the Na electrolyte. The spectra shown in Figs. 27 and 28 show a nearly complete coverage of the surface by Zn oxides or hydroxides. Pt and Mg are also visible on the surface. There was a small feature adjacent to the Mg 2p peak that could not be positively identified. However, a comparison with the feature obtained from Sample #7 shown in Fig. 28 shows that this peak is at a somewhat lower binding energy, and that its source is not the same as the feature in the spectrum from Sample #7.

No substantive information could be obtained from Sample #13 which came from an electrode run at HPC. This sample showed approximately the same characteristics as Sample #11, i.e., the surface was heavily covered with Pt. Spectra from this sample are shown in Figs. 29 and 30.

Sample #14 represented the best spectrum for a direct comparison between the electrode surfaces that are generated by the two types of electrolytes. The spectra shown in Figs. 31 & 32 indicate that the extraneous contamination is minor and does not obscure the interpretation of the data. There is only a very small trace of Mg

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in the energy region of primary interest.

The comparison between electrodes which have been used in the two types of electrolyte solutions the is explored further in the spectra shown in Figs. 32 & 33. The two samples represented by the spectra were prepared at HPC, and heat data is available for both. From a compositional and surface chemical standpoint, there are several similarities and differences between the samples. Both samples have small amounts of Si, Mg and S on the surface. The concentrations of these are not the same on both surfaces, but they are of the same order of magnitude. The Na sample has a small amount of lead on the surface; the K sample does not. The K sample has both K and In on the surface; the Na sample does not. Chemically, the Ni oxide layer on the K sample is thicker and more hydrated than on the Na sample. The most important difference is the fact that the K sample has the spectral feature at about 57 eV. There is no evidence of any structure in this region on the Na sample. The difference is most clearly illustrated in Fig. 34. I have been unable to associate the spectral feature at about 55 to 57 eV with any surface contaminant element, and the spectral comparison in Fig. 33 represents the best evidence to date for hydrino atoms.

Results - Cleaning treatments

The last figure, Fig. 35, illustrates the results of some cleaning

experiments that were carried out very early. The samples consisted of a piece of electrode material cleaned and treated with both peroxide and K electrolyte by Randy Mills at the time of starting the first experiment and other pieces of electrode material that were solvent cleaned only, cleaned with solvents and peroxide only, cleaned with solvents and immersed in electrolyte only, and cleaned with solvents and treated in the peroxide/electrolyte mixture. I carried out the latter experiments at Lehigh. The techniques used by HPC were duplicated to the best extent possible. Unfortunately, low binding energy region data were not obtained for some of the samples, but there are overall compositional results for all the specimens. The only elements present on the surface of the solvent cleaned and peroxide cleaned surfaces were Ni, O and C. After a 30 min immersion in K electrolyte only, a solvent cleaned sample showed that a small amount of Sn (<1 at.%) had deposited on the surface. Three pieces of electrode material were treated in the combined solution: one by Randy Mills and two by myself. The surface of the Mills' cleaned sample contained only Ni, O, and C. Both Zn and Sn were present on the two samples that I treated. Both of my specimens were treated in the same batch of peroxide/electrolyte solution, and the first of the two samples had far more of contaminant elements than the second. It may be that the solution "cleans up" as more sample area is treated, and that the amount of contaminant on the electrode surfaces will be a function of the history of the solutions.

The interesting aspect of the data shown in Fig. 35 is the feature at about 57 eV. It is present only on the two samples that I cleaned. However, the magnitude of the feature is about the same in both spectra even though there are clear differences in the amount of Zn and Sn on the surface as shown by the peaks at 10 eV and 28 eV. This is evidence that the feature is not related to Zn and Sn contamination. I was unable find any other elements on the surface that cause the feature.

In summary and conclusion, the following positive observation is offered:

1.   The persistent appearance of a spectral feature near the predicted binding energy for many of the electrodes used with a K electrolyte is an encouraging piece of evidence for the existence of reduced energy state hydrogen.

Other observations which do not discount the identification of the spectral feature as reduced energy state hydrogen, but which introduce uncertainty into the interpretation of the spectral feature are:

1.   The spectral feature is only observed when there are contaminant elements of some type also present on the surface. However, it has not been possible to identify the feature as being directly related to any of the identified contaminants.

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2. The feature persisted in Sample #1 even after being heated to >700°C. Normally, it is expected that hydrogen would diffuse out of the sample at these temperatures. In addition, the shape of the feature changed as result of heating.

3. Two of the hydrogen peroxide/potassium electrolyte treated foils exhibit the feature while another one does not. Coincidentally, the surfaces showing the feature have contaminant elements, whereas the surface not showing any contamination does not have a definable feature.
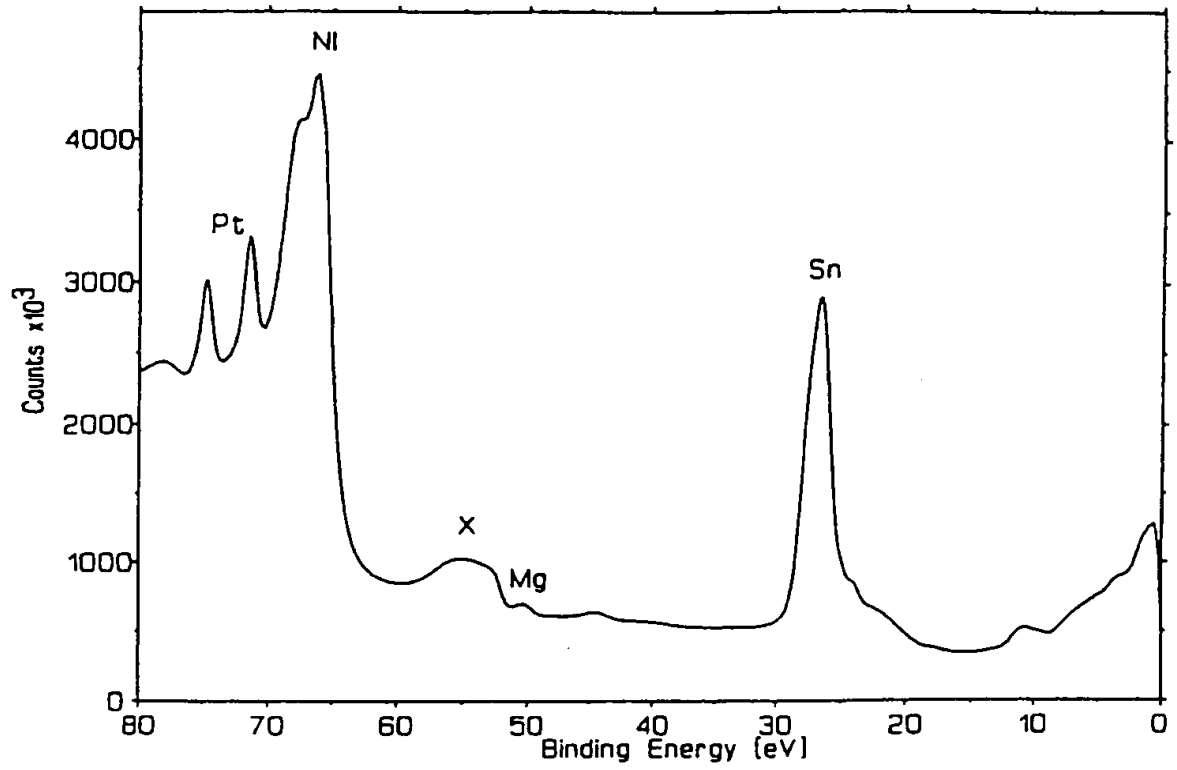
4. The postion of the feature varied over about 2 eV if we examine all of the specimens. This would not be expected.
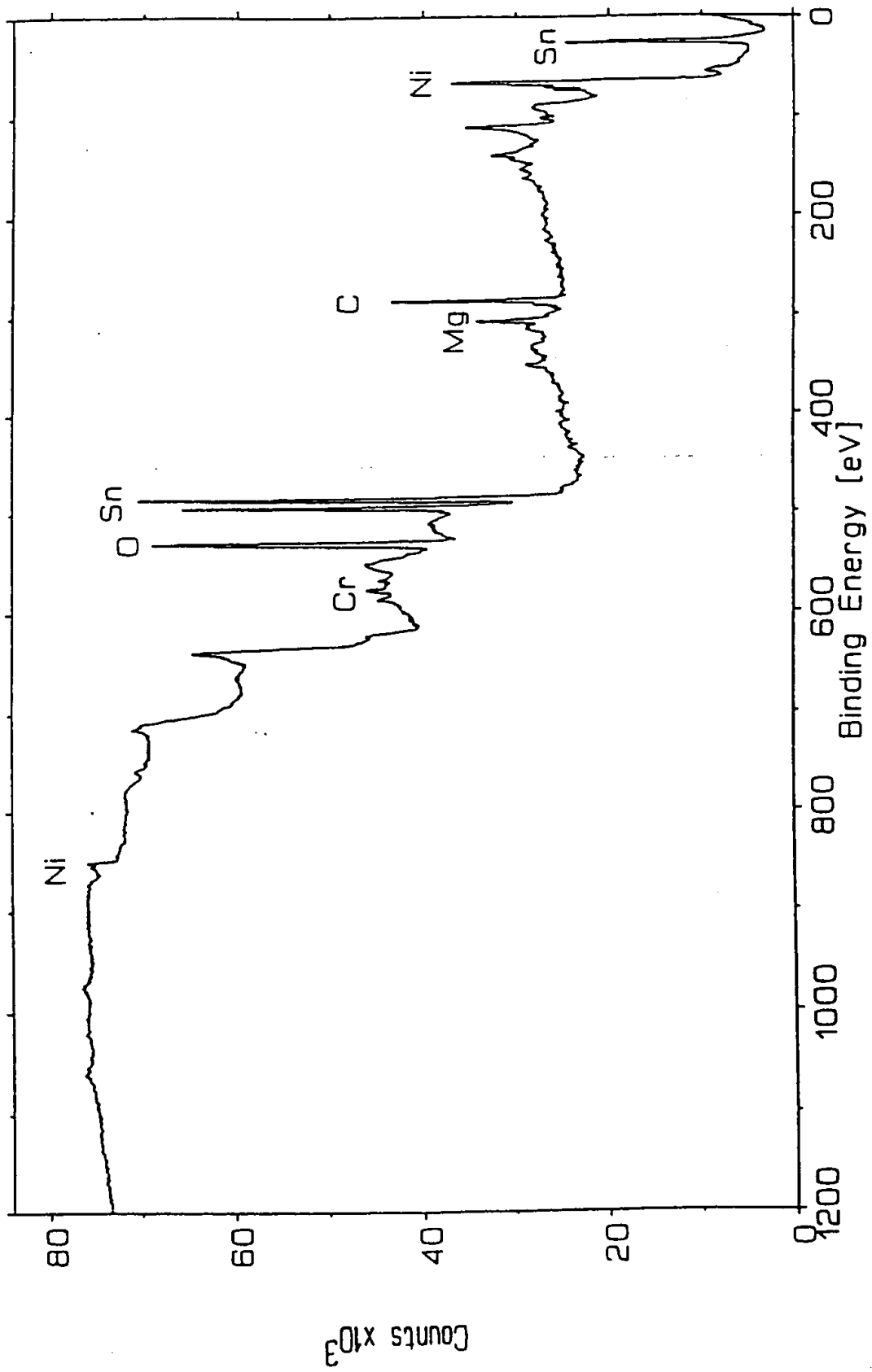
Figure 1

Figure 2
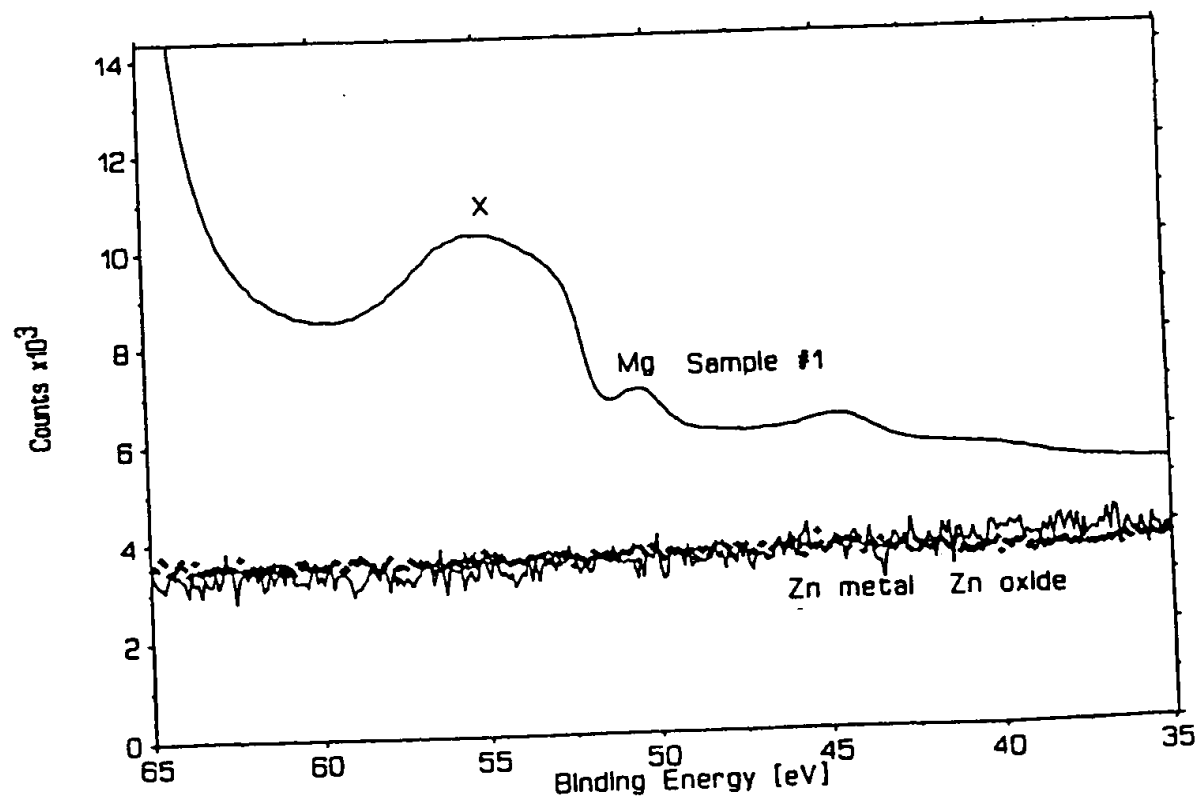

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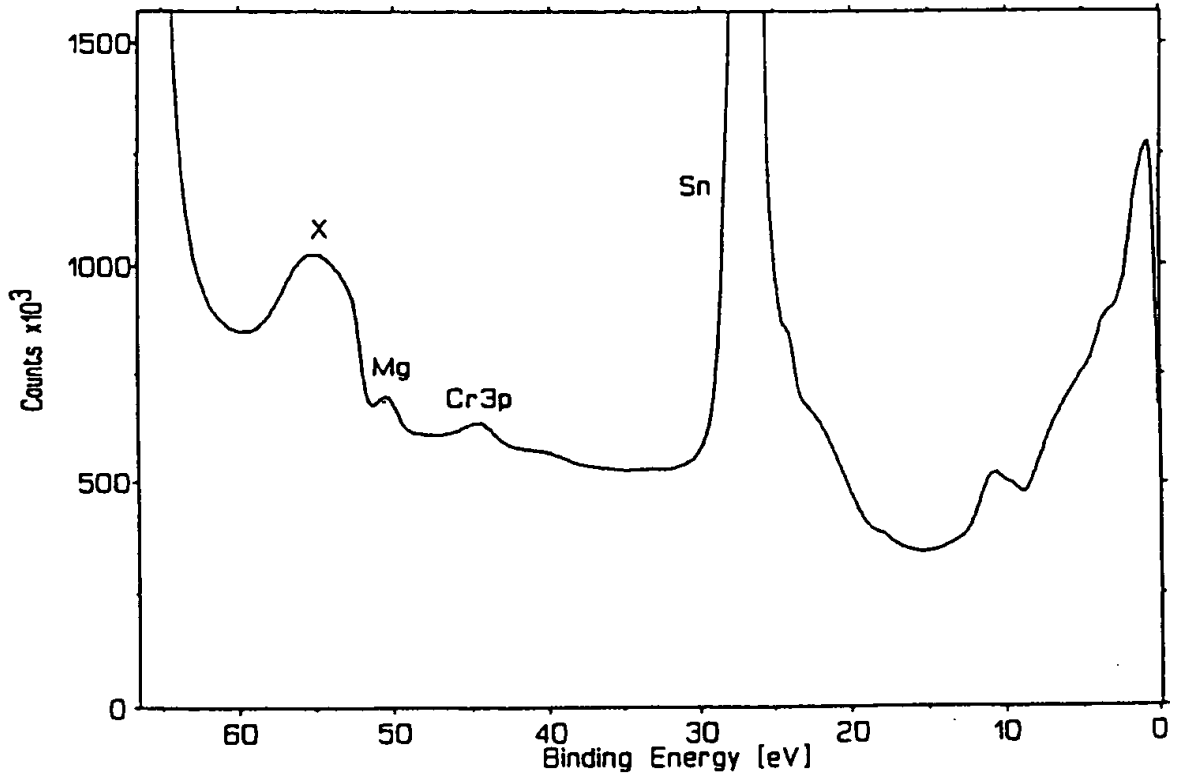
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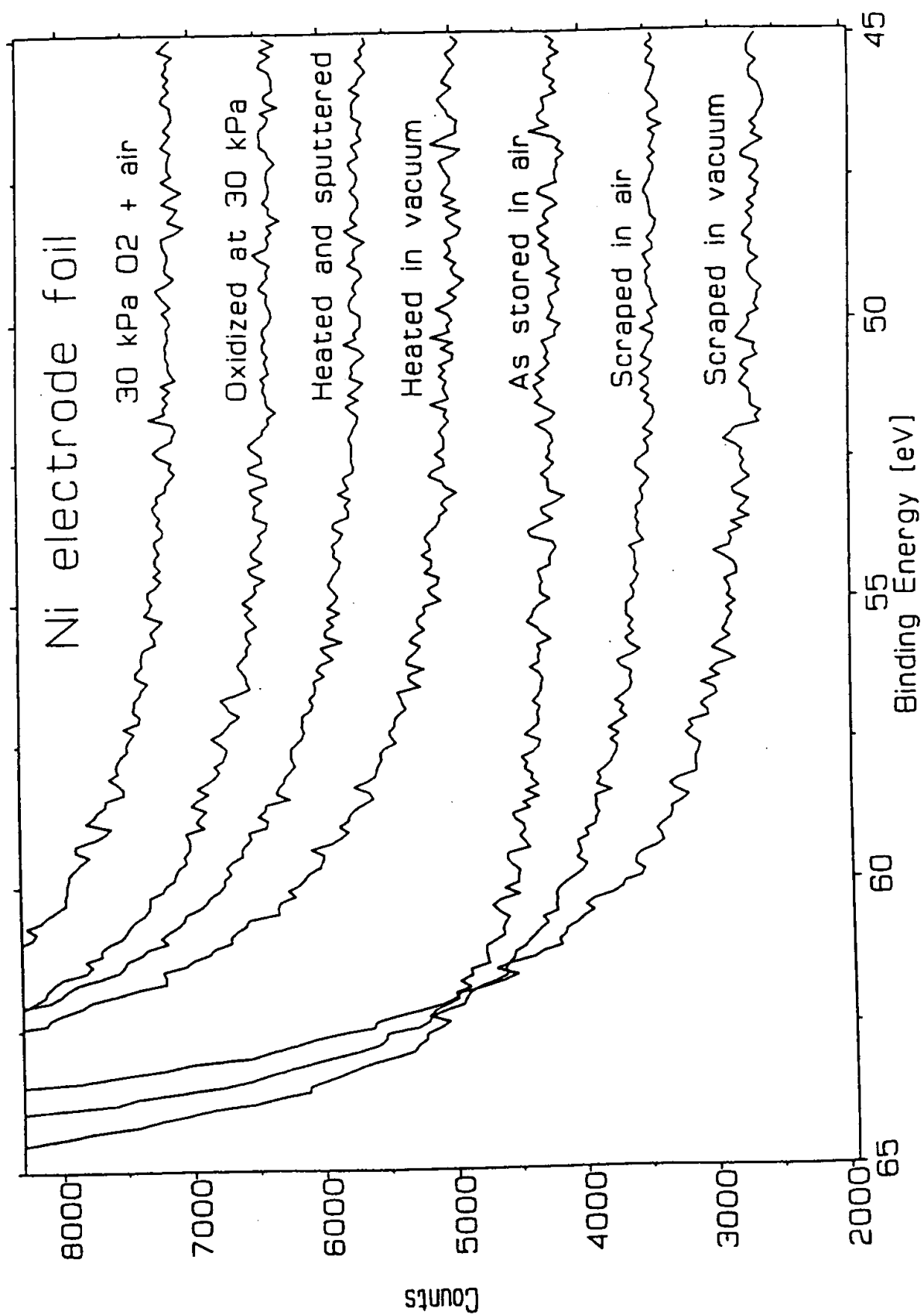
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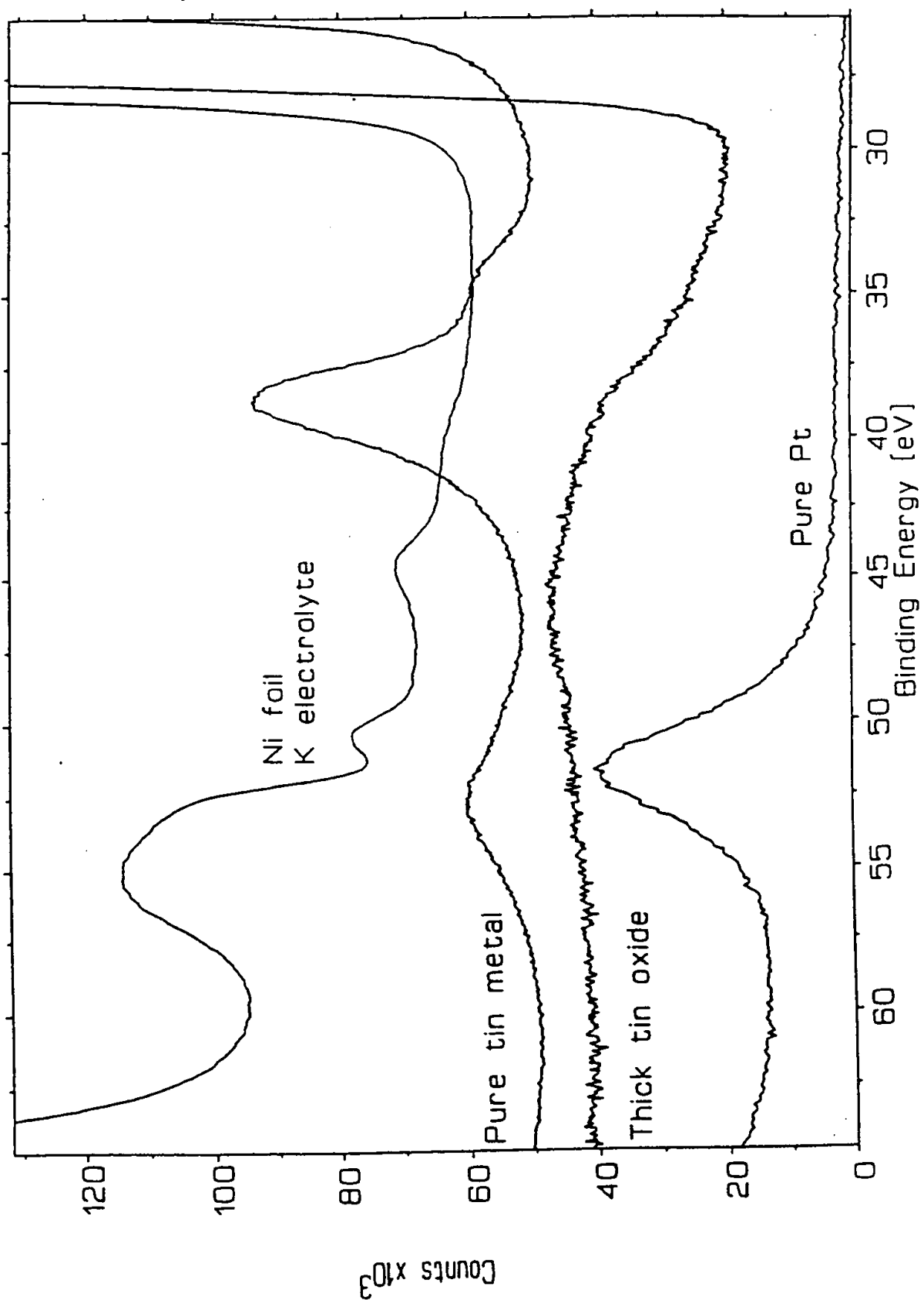
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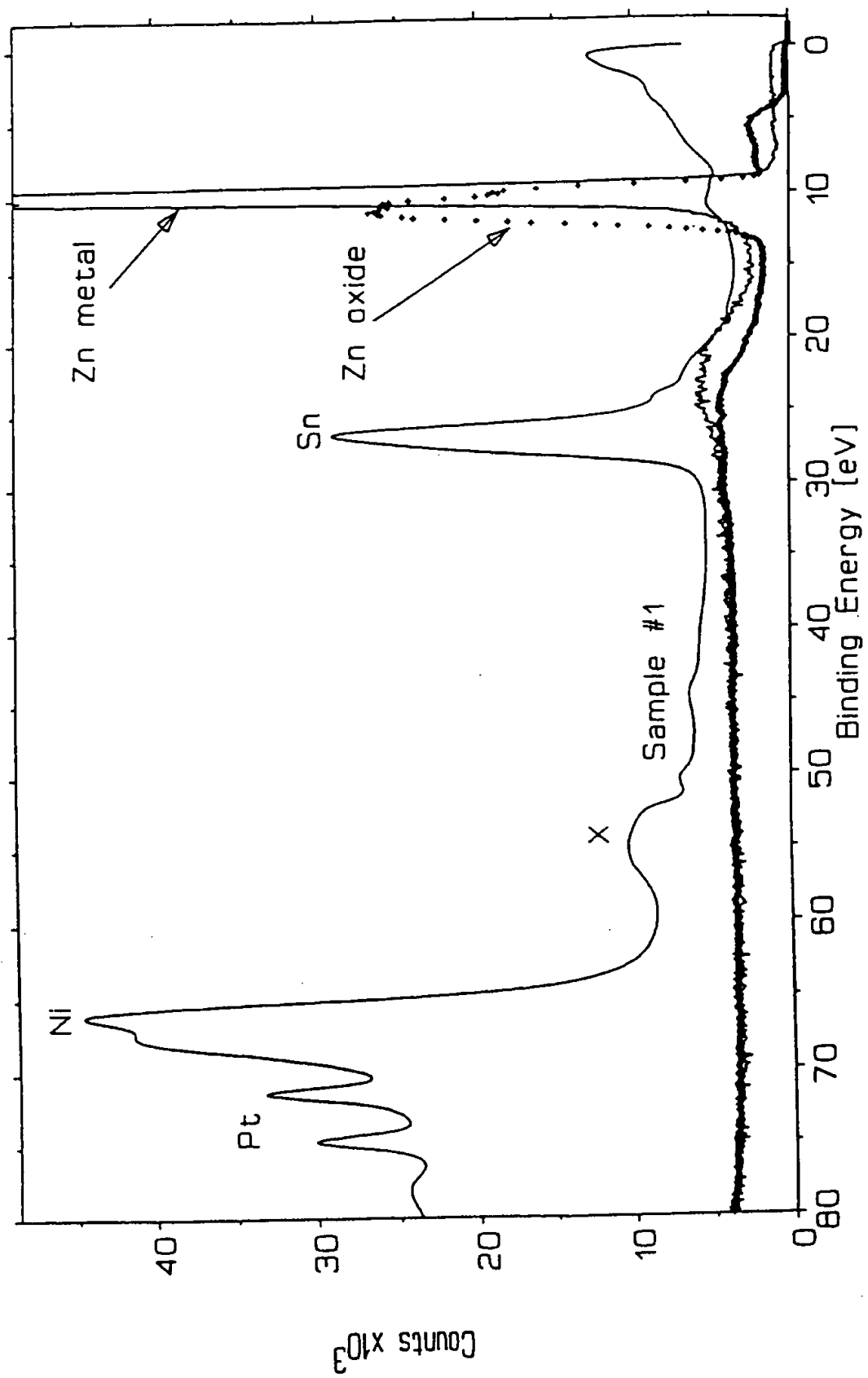
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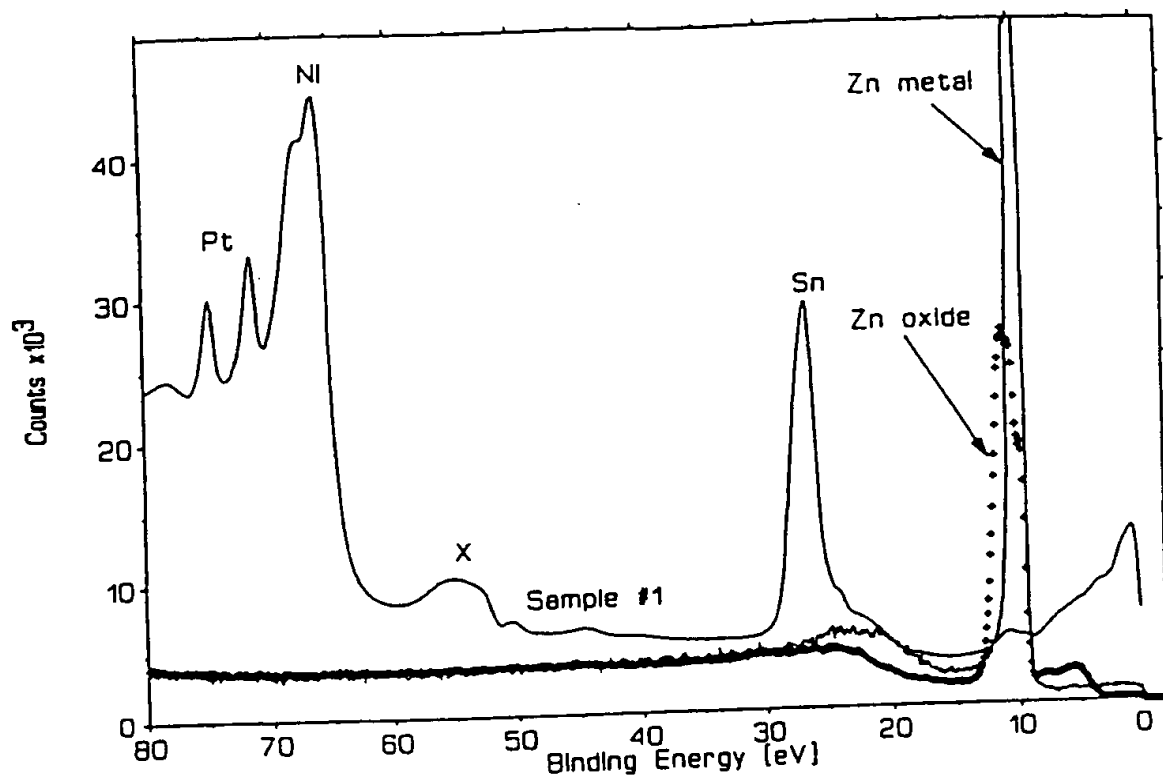
ZINC.007

ZINC.007

Figure 7
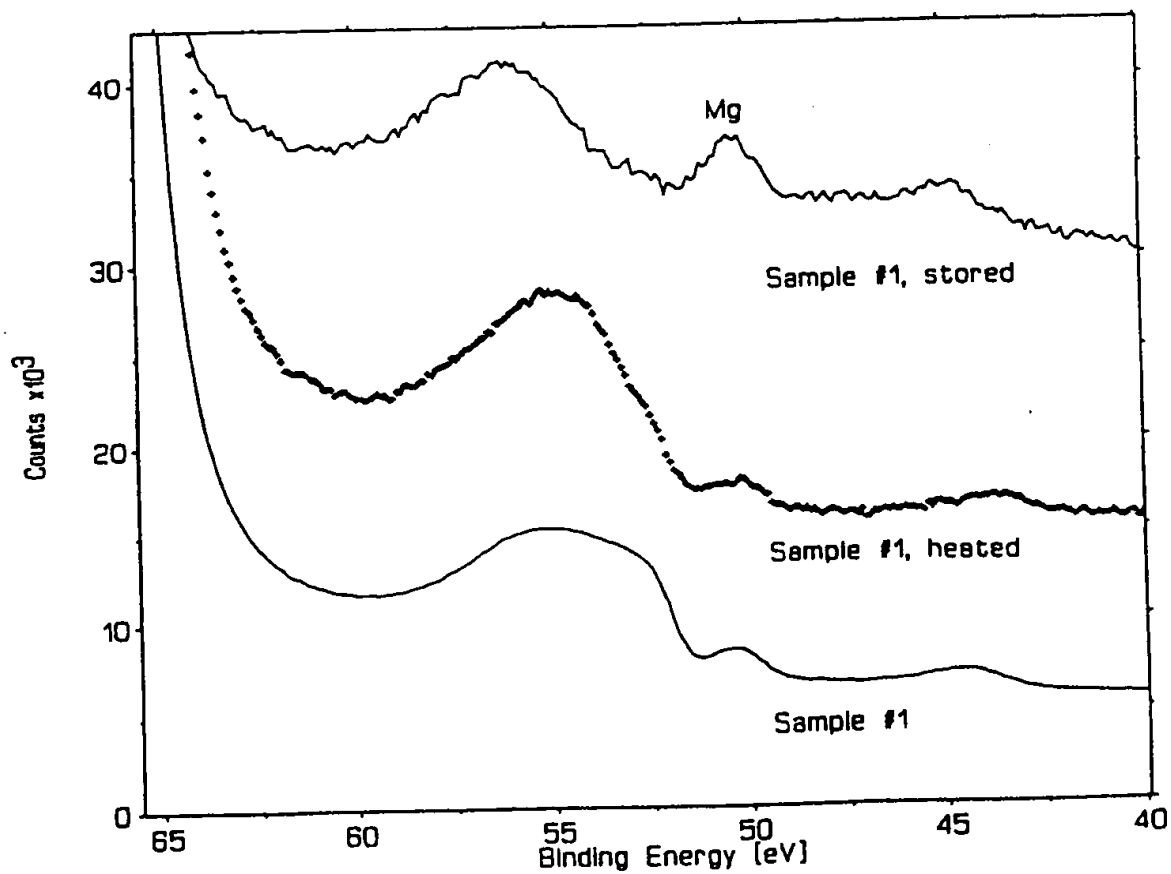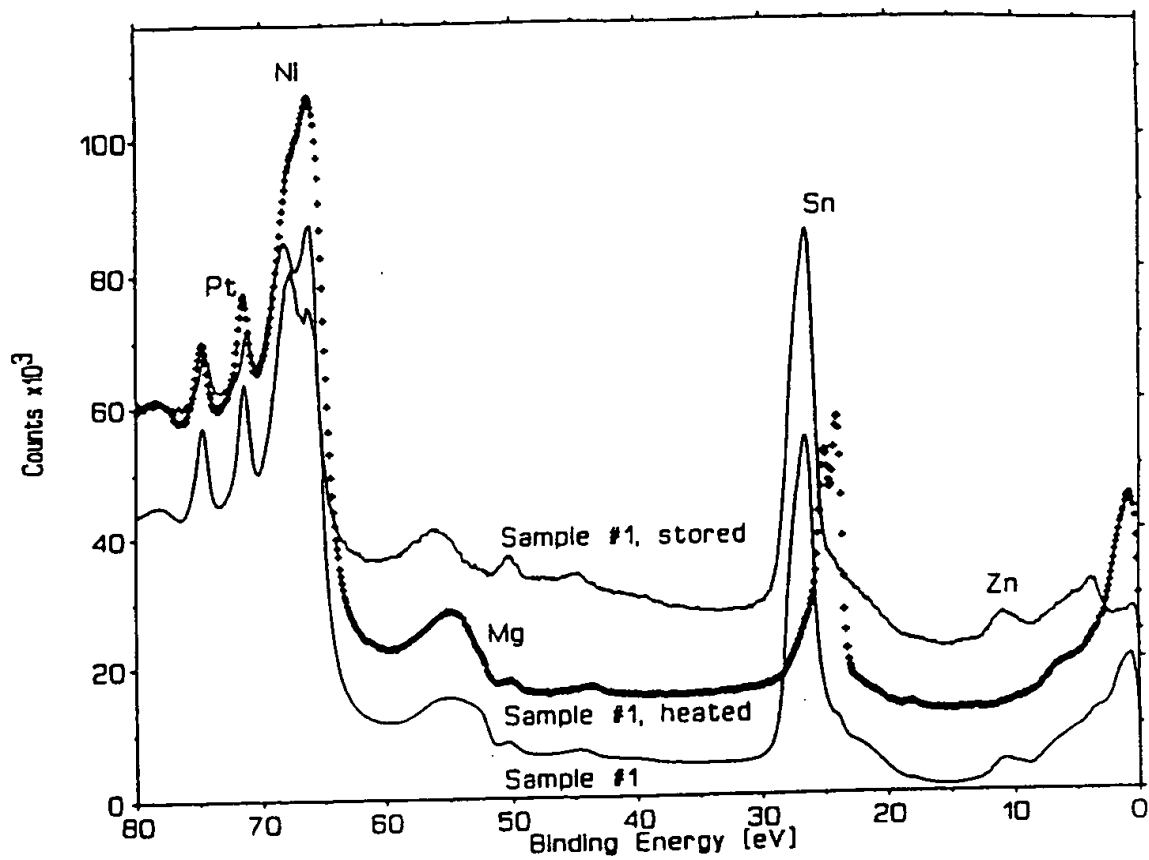
Figure 8
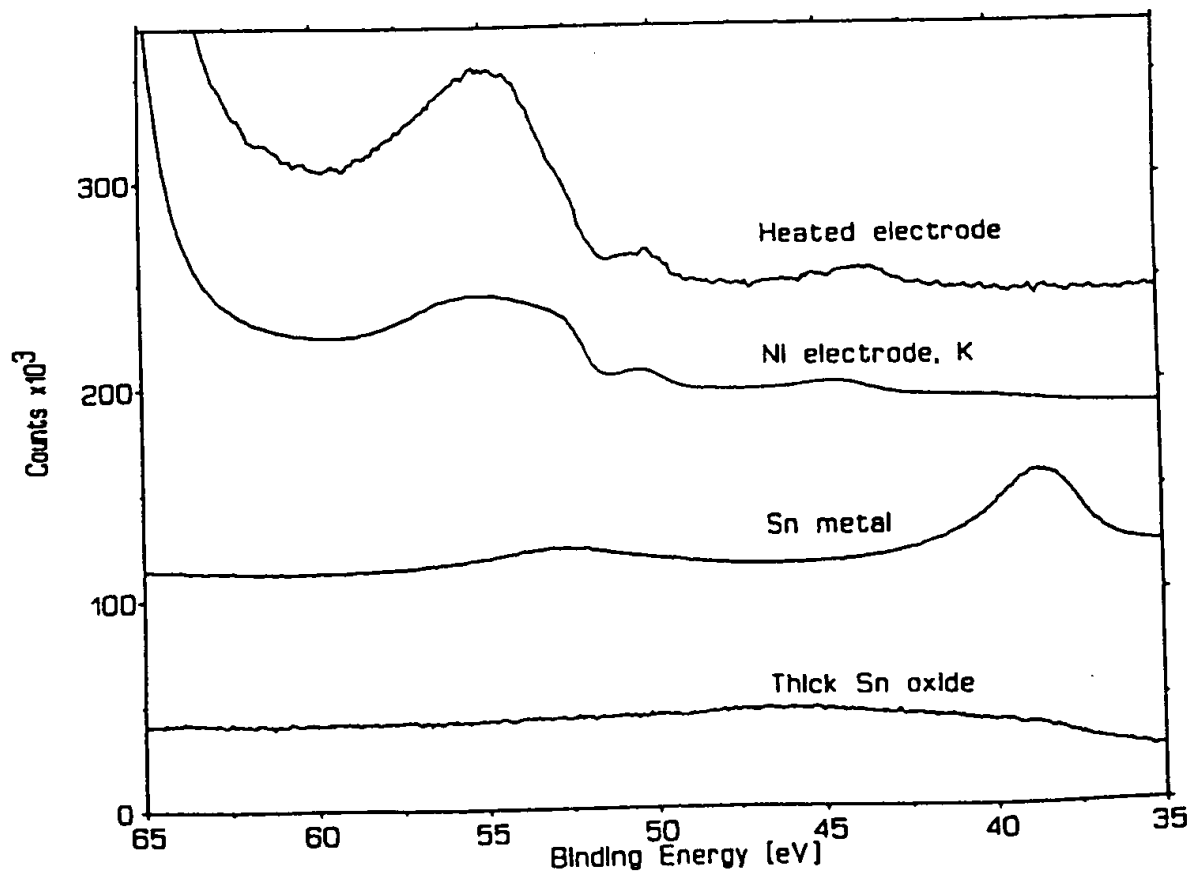
Figure 9

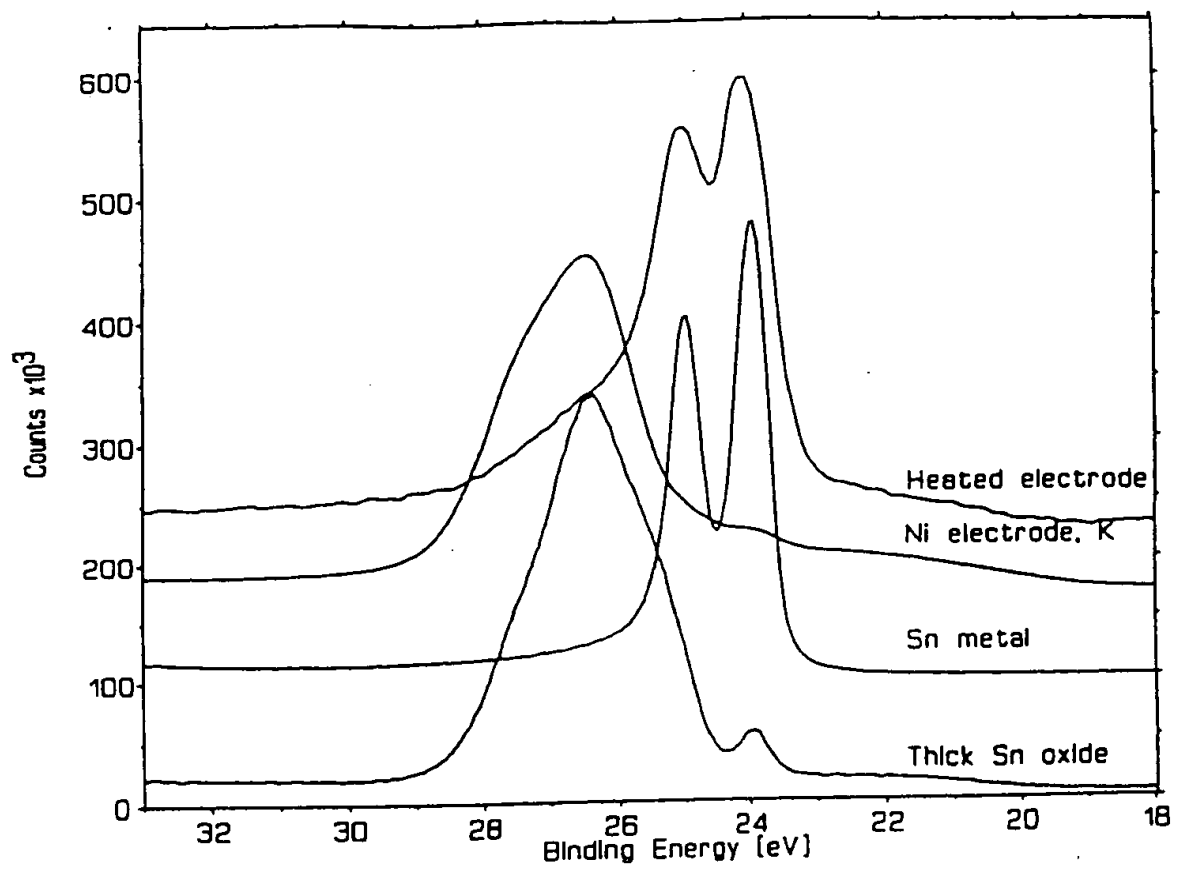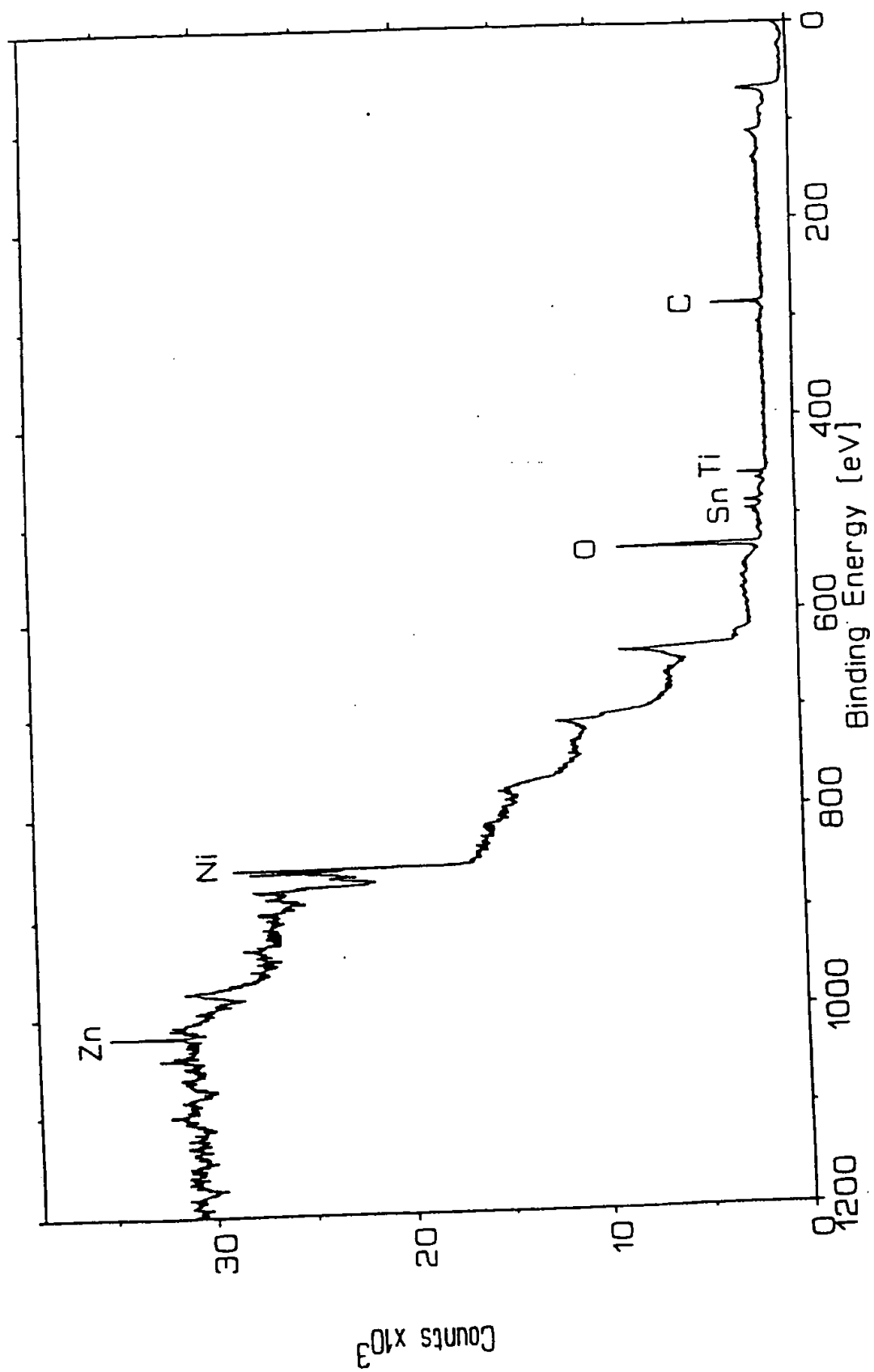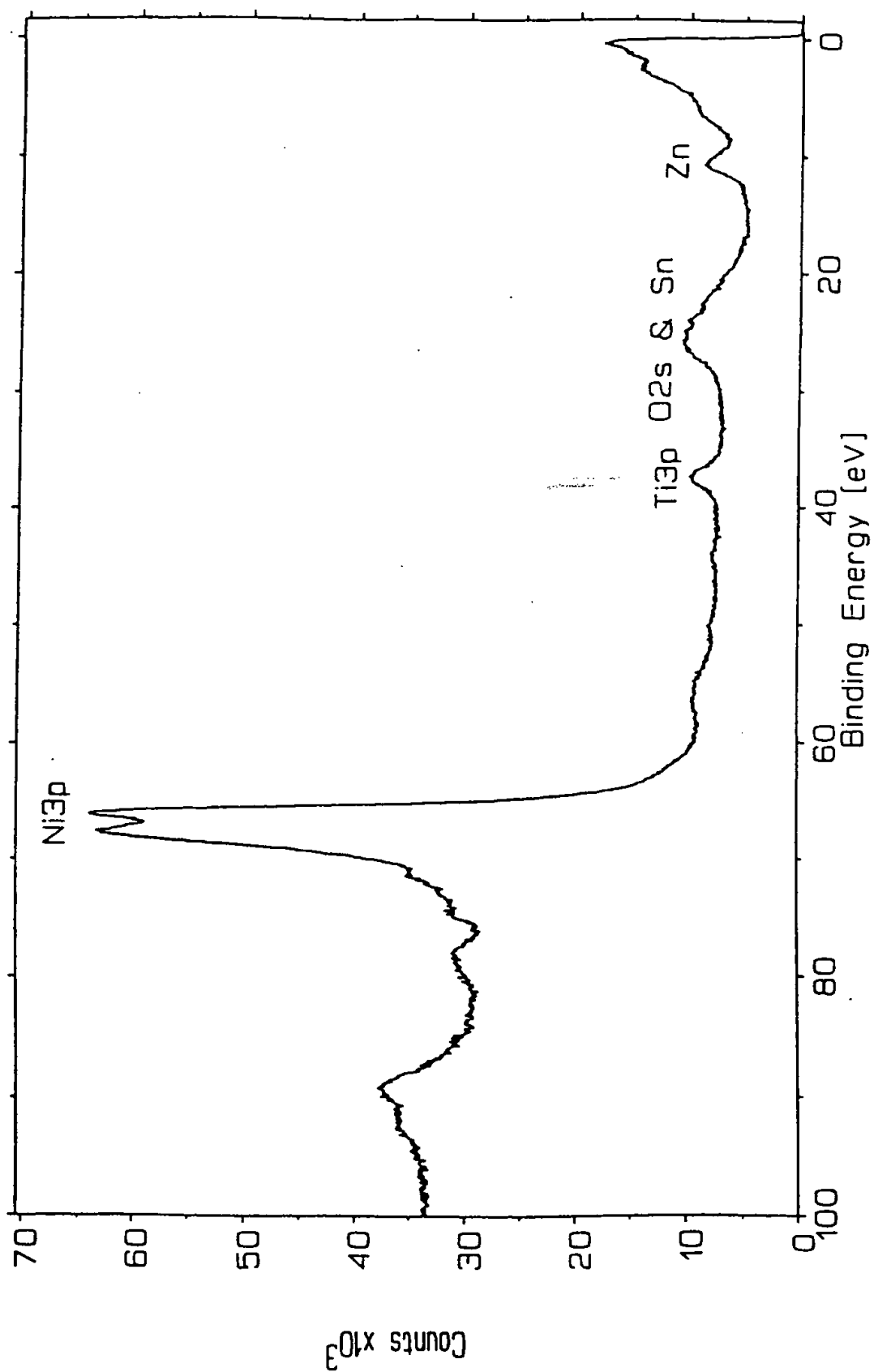Figure 10

Figure 11

HPCK-02.002
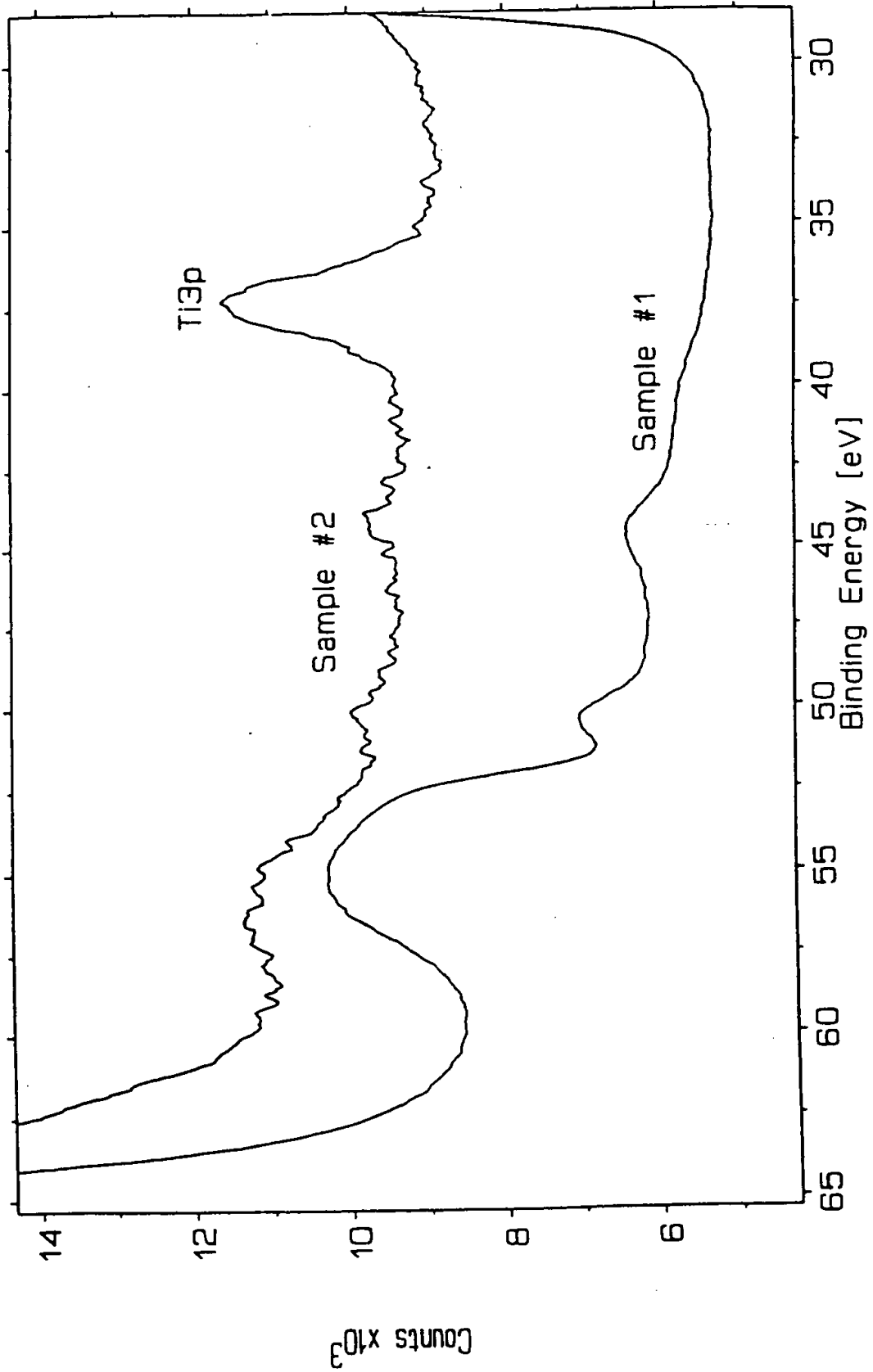
Figure 12
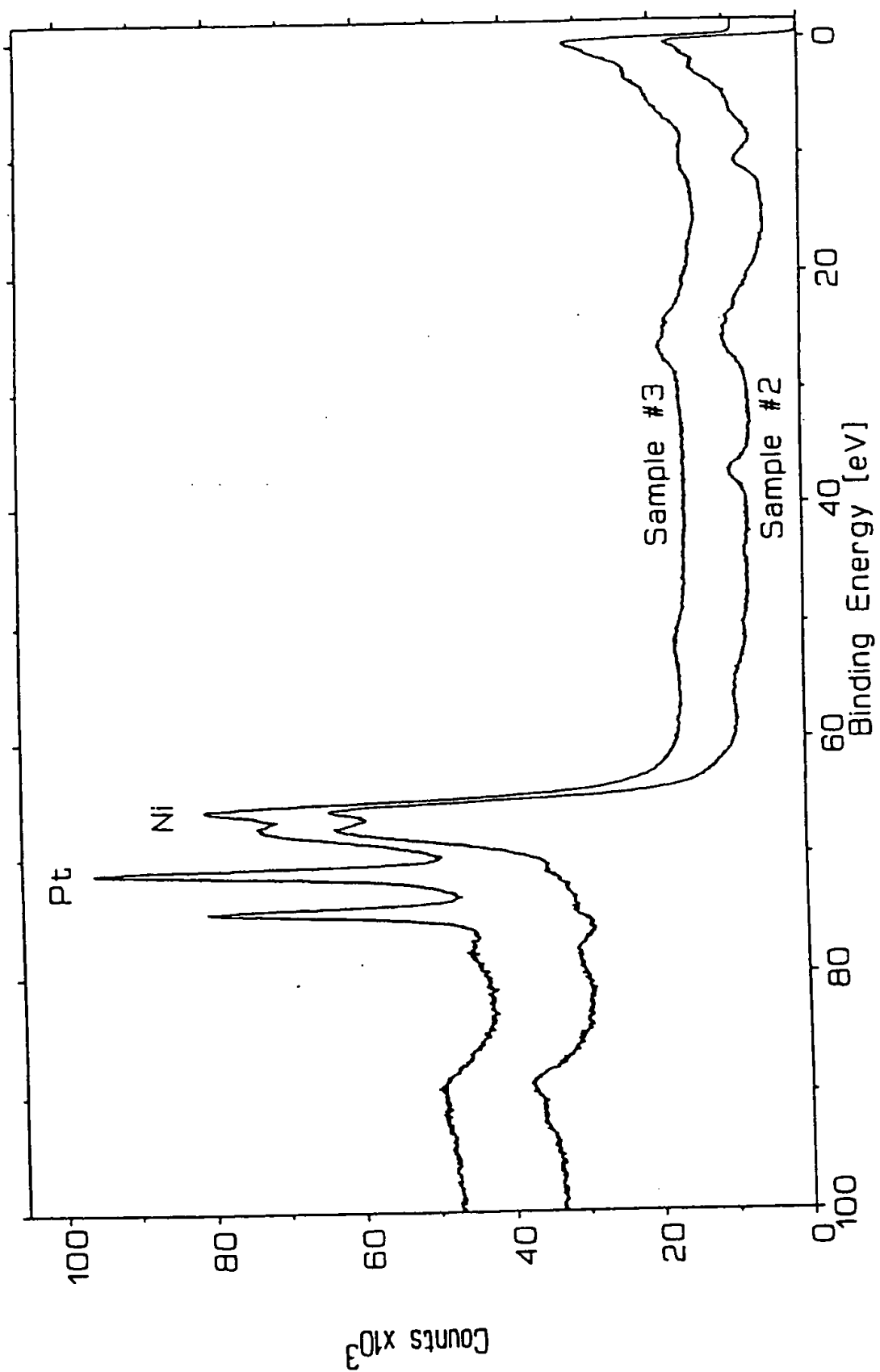
HPCK-03.002

Figure 13
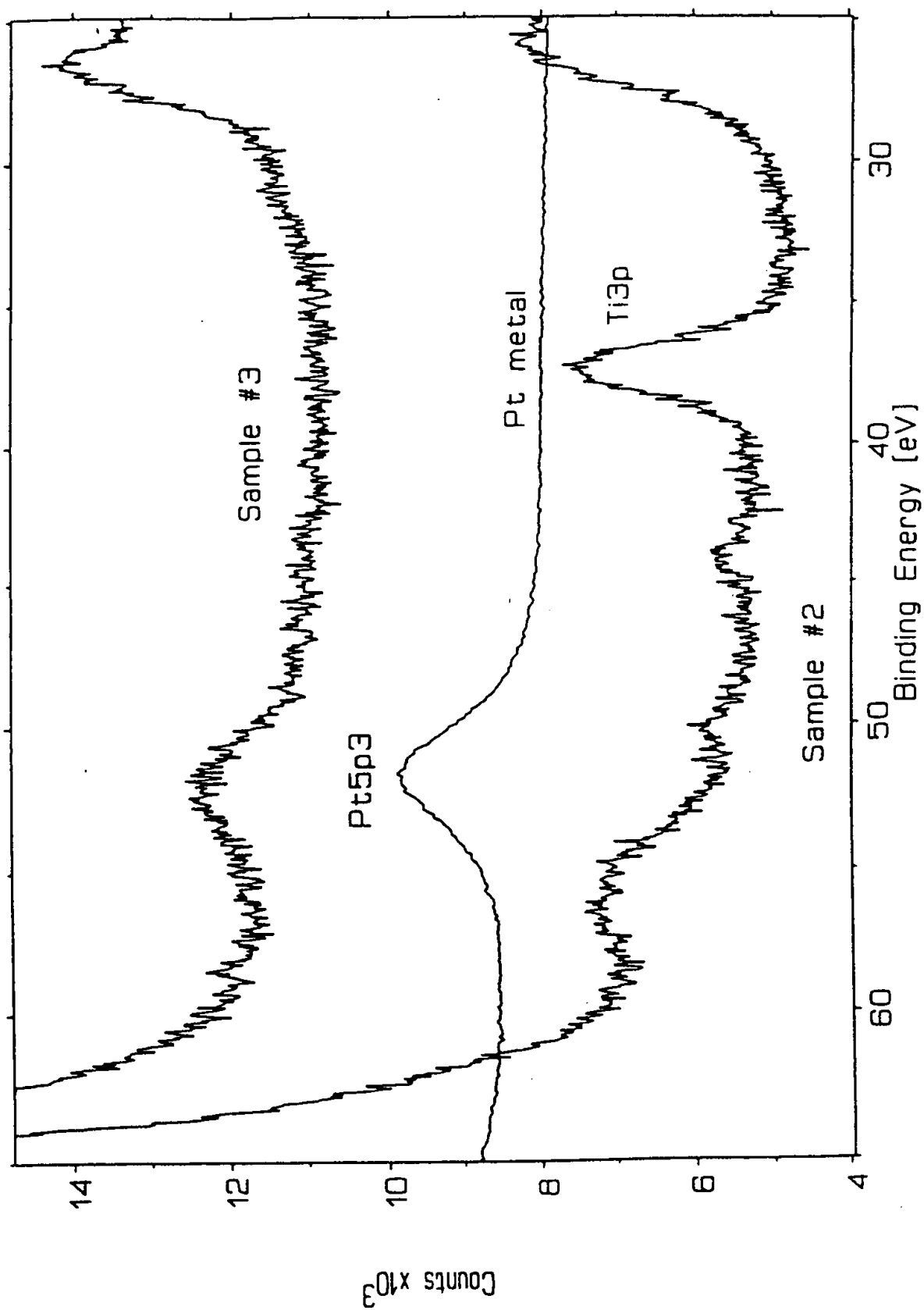
Figure 14
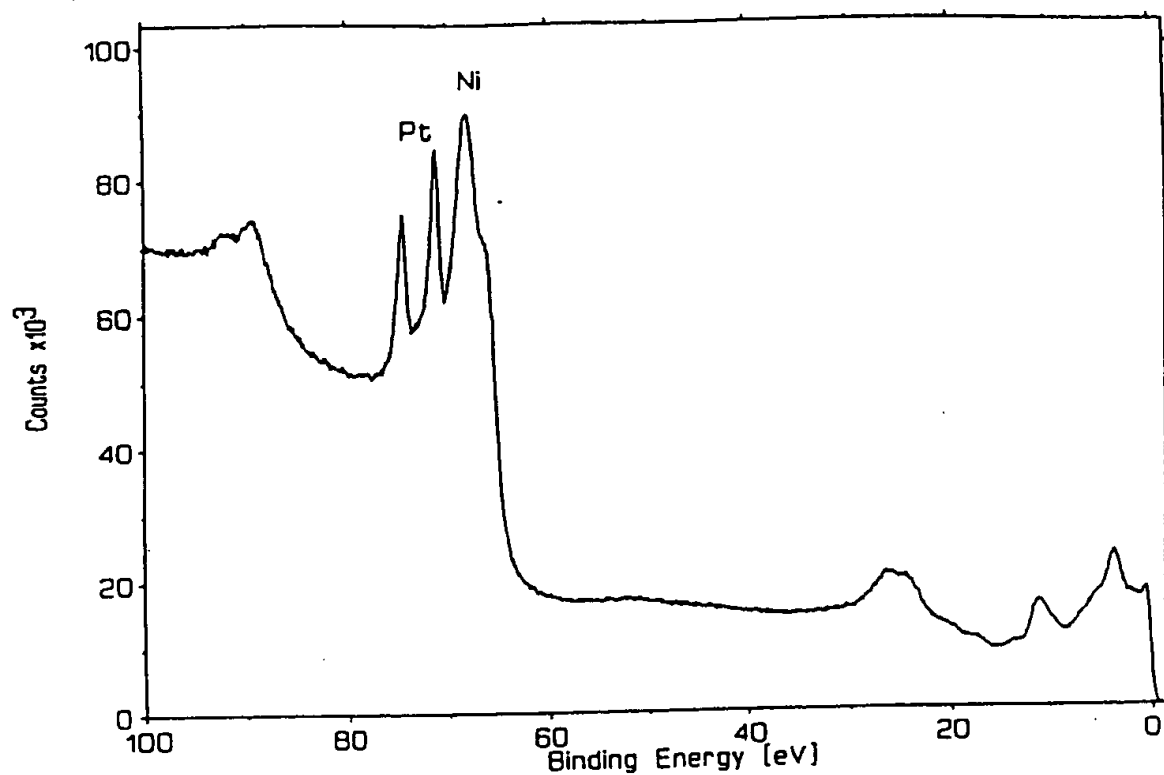
HPCK-05.001
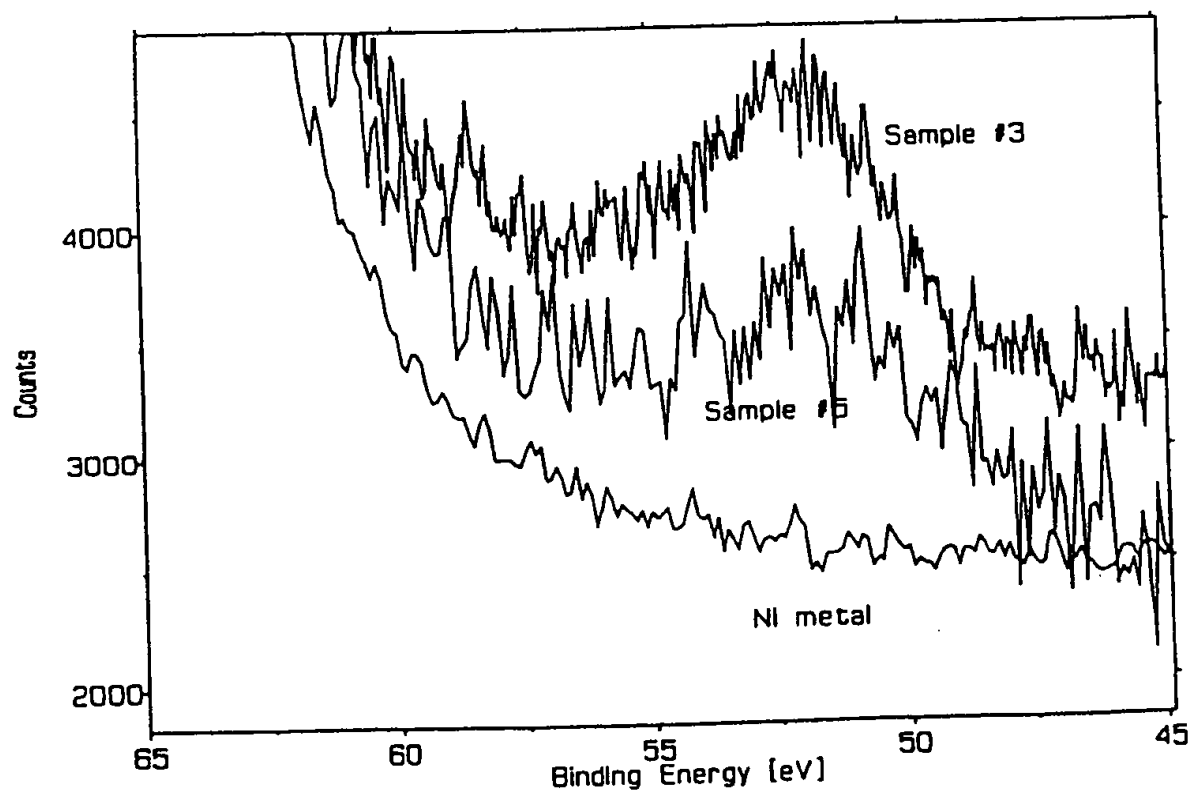
HPCK-05.001

Figure 15
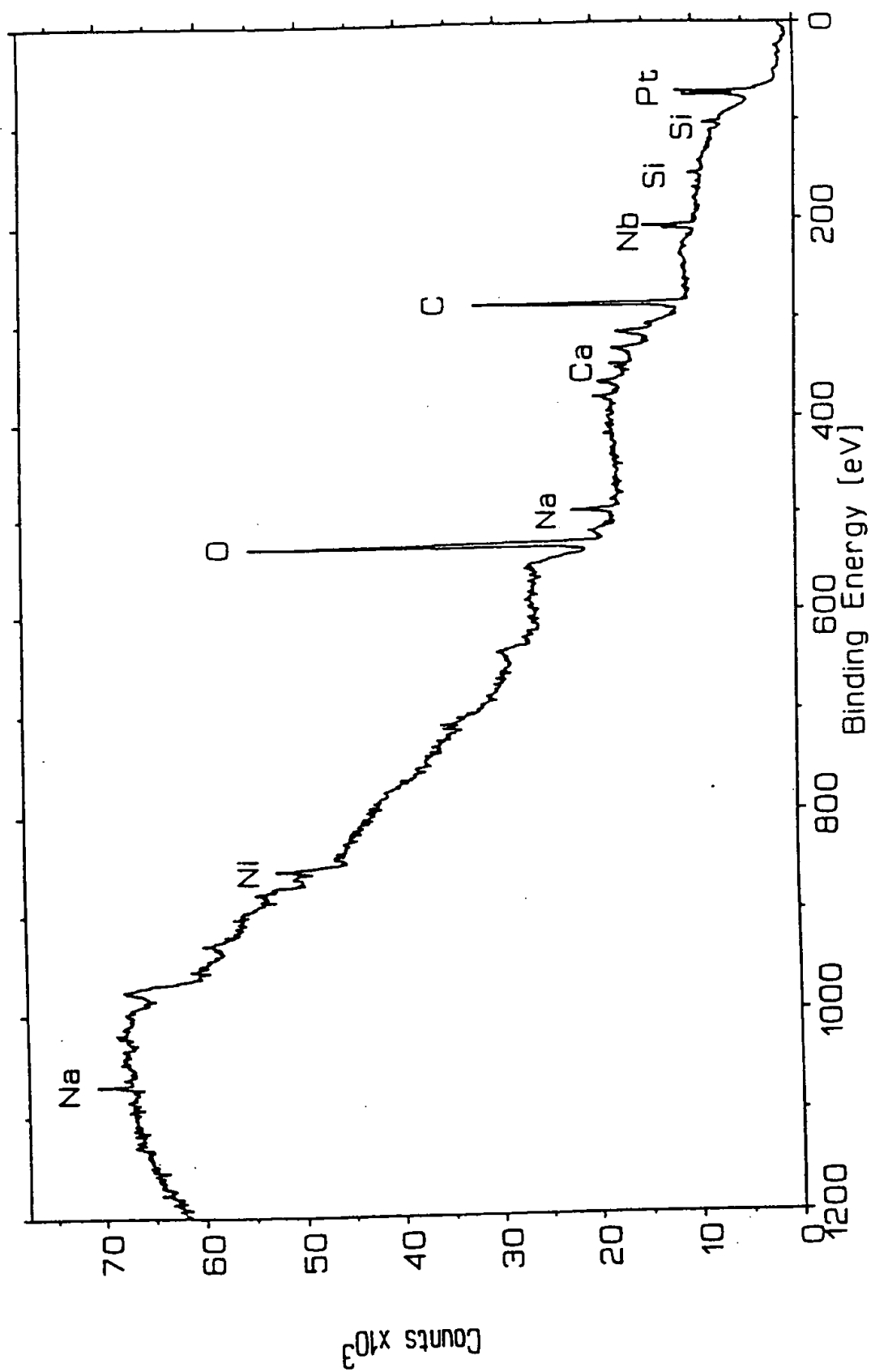
Figure 16

HPCK-06.001

Figure 17

Figure 18

Sample #7

HPCK-07.002

Sample #1

Sample #1, heated

Sample #7
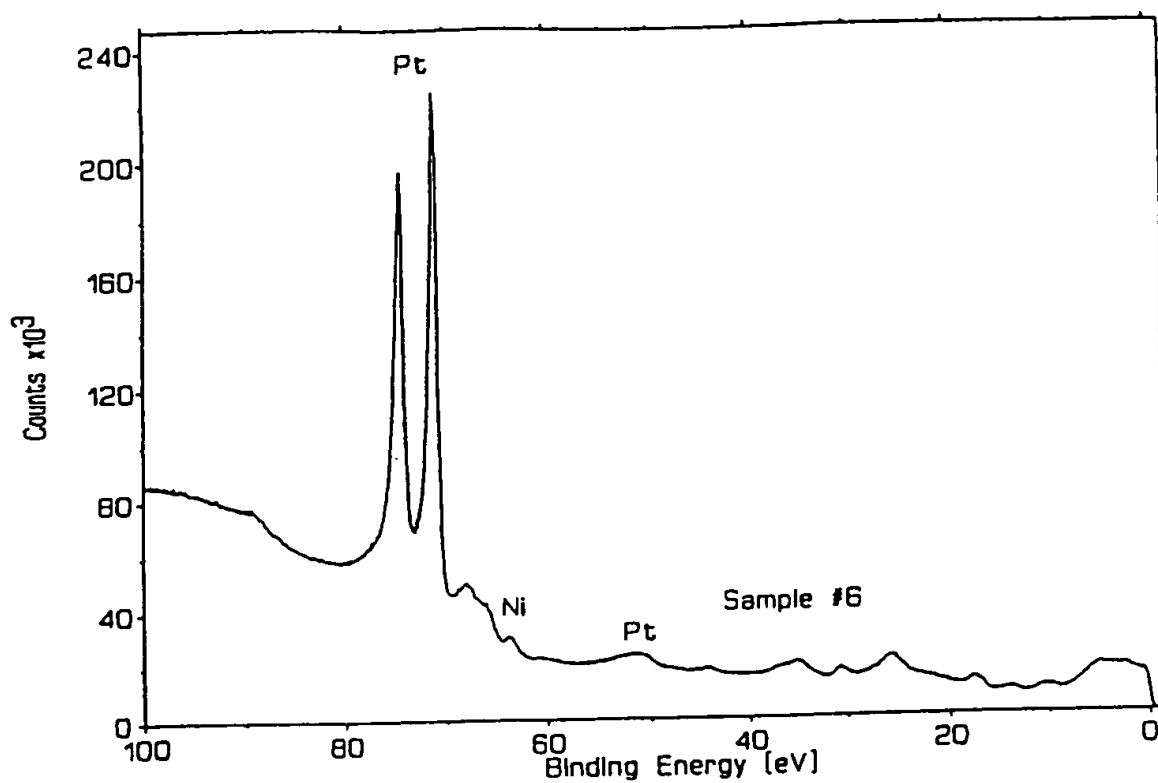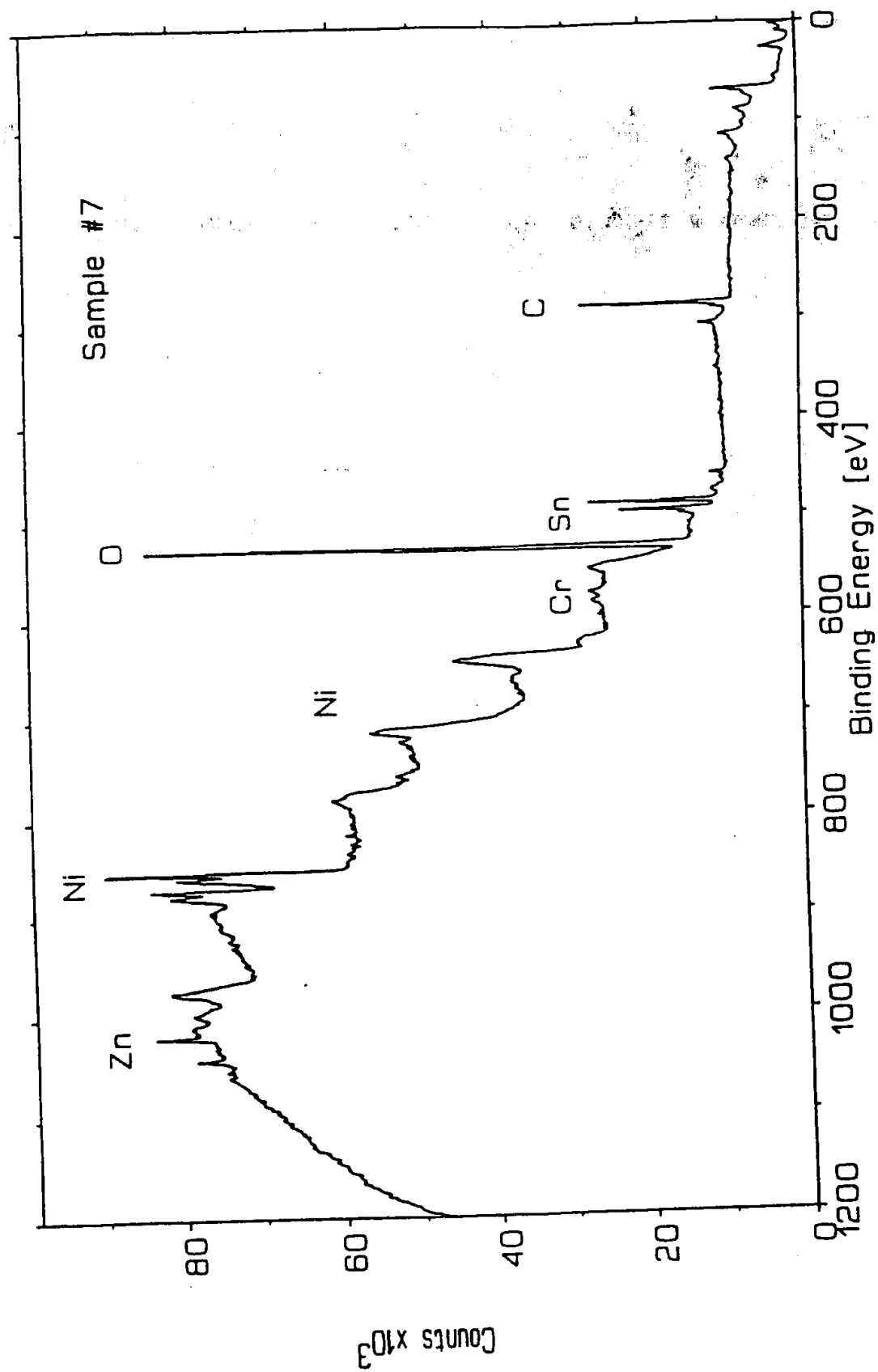
HPCK-07.002
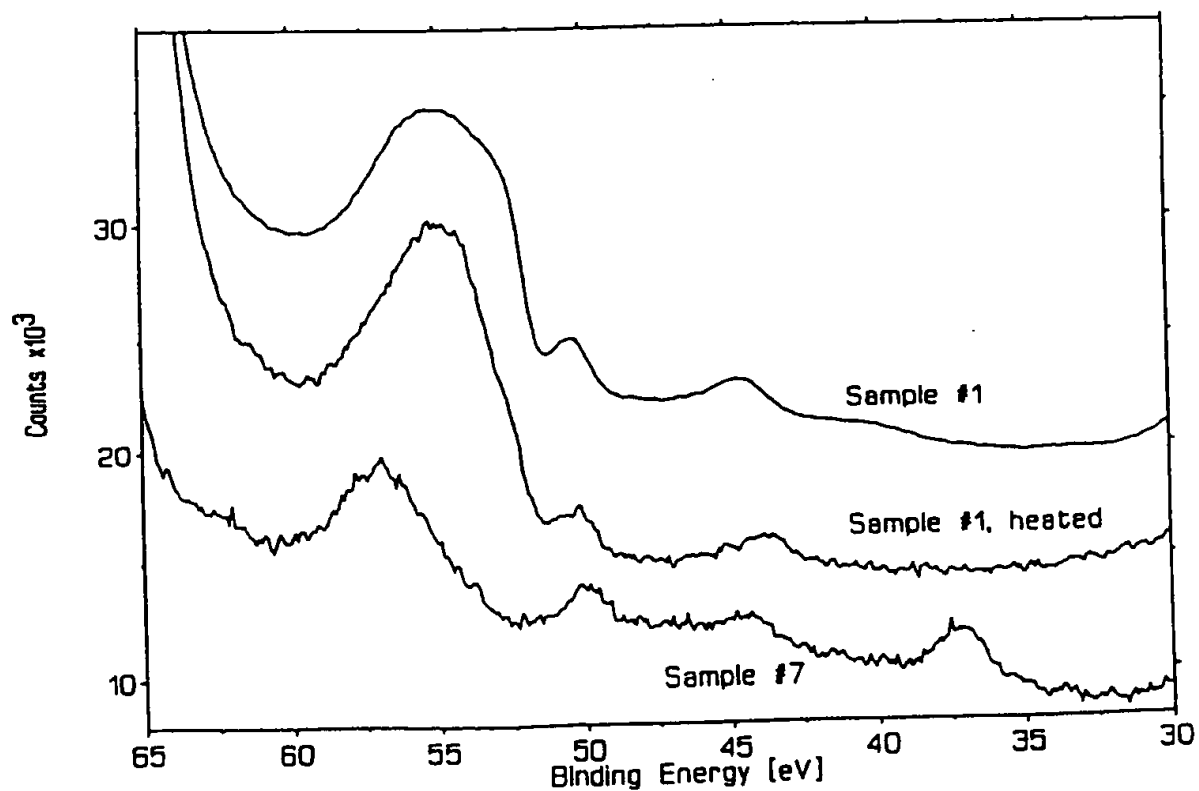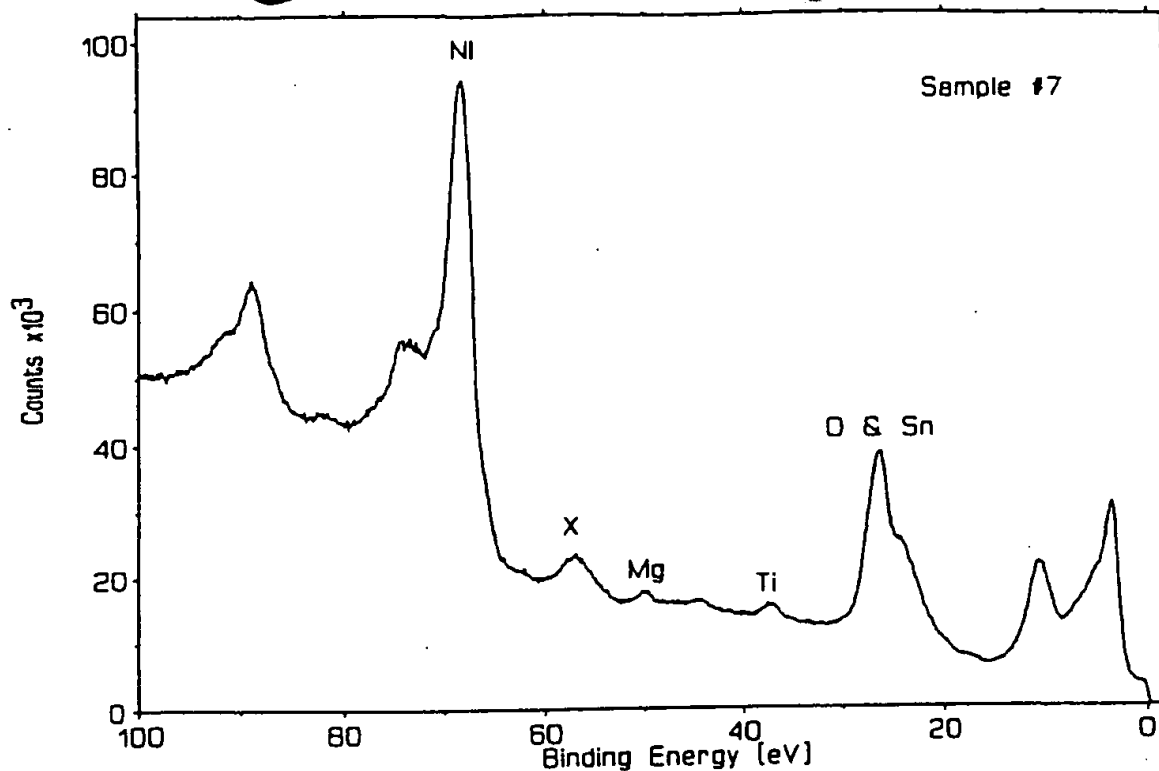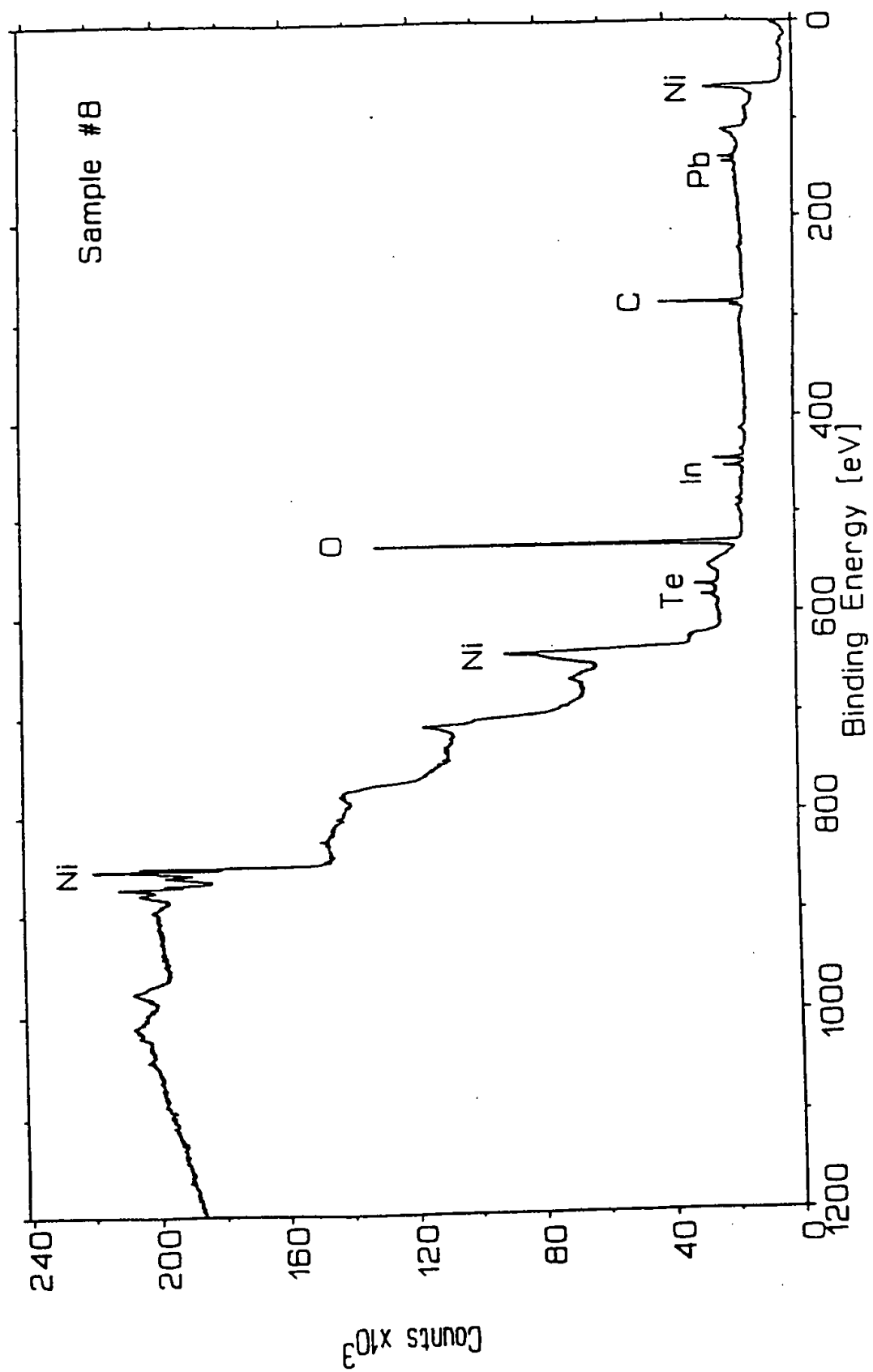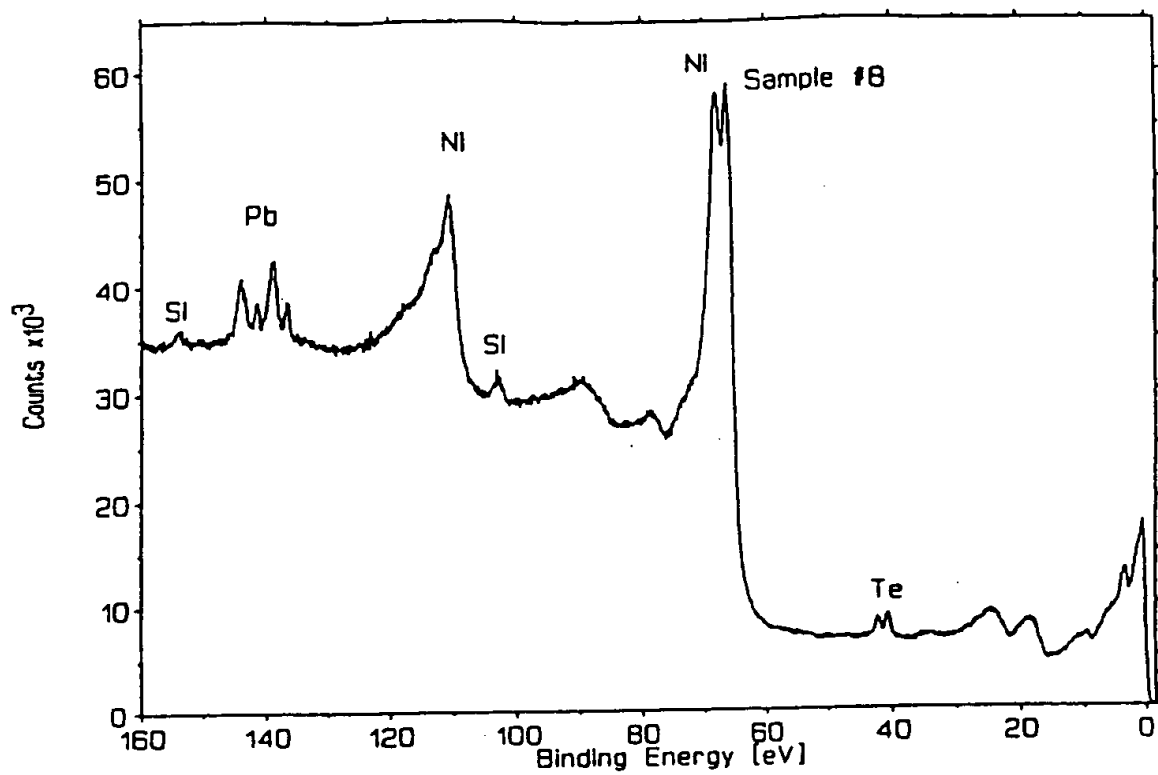
Figure 19

Figure 20

HPCK-08.003

HPCK-08.003

Figure 21

Sample #9

X-axis: Binding Energy [eV], 0 to 1200

Y-axis: Counts x10³, 0 to 300

Peaks labeled: Ni, C, K, In, O, Ni, Ni
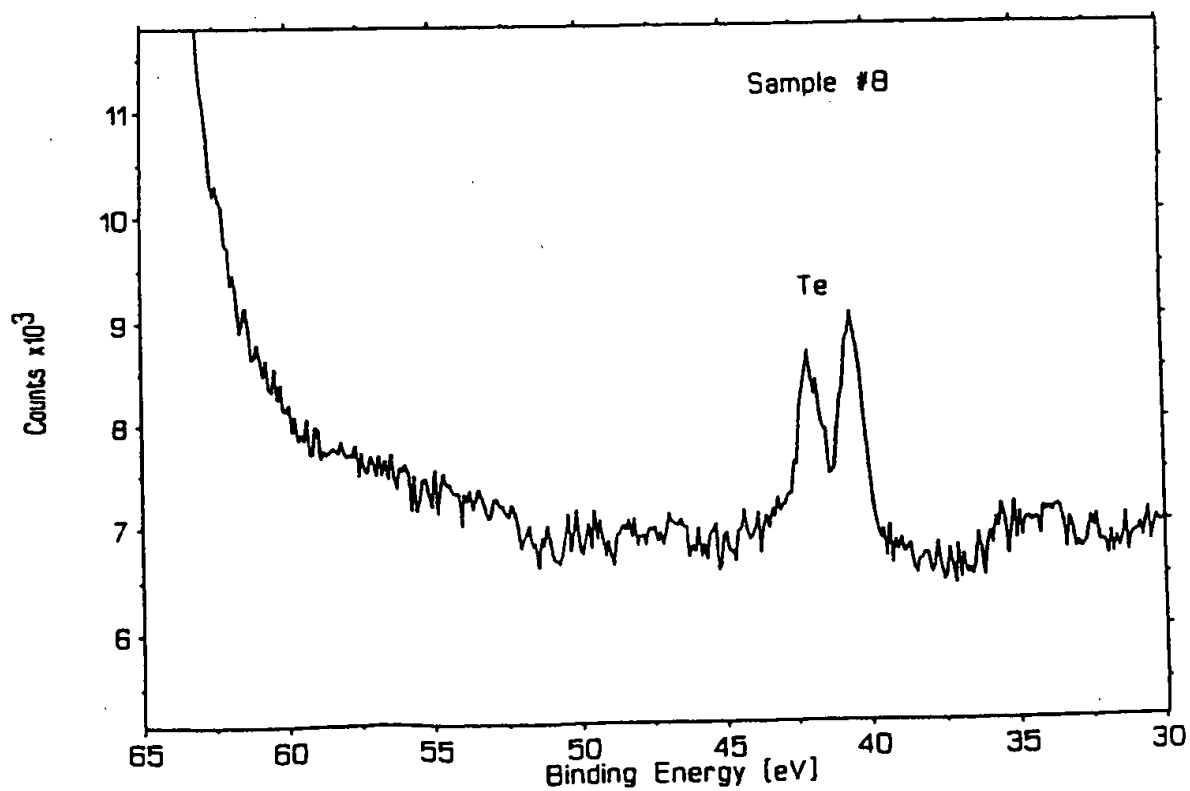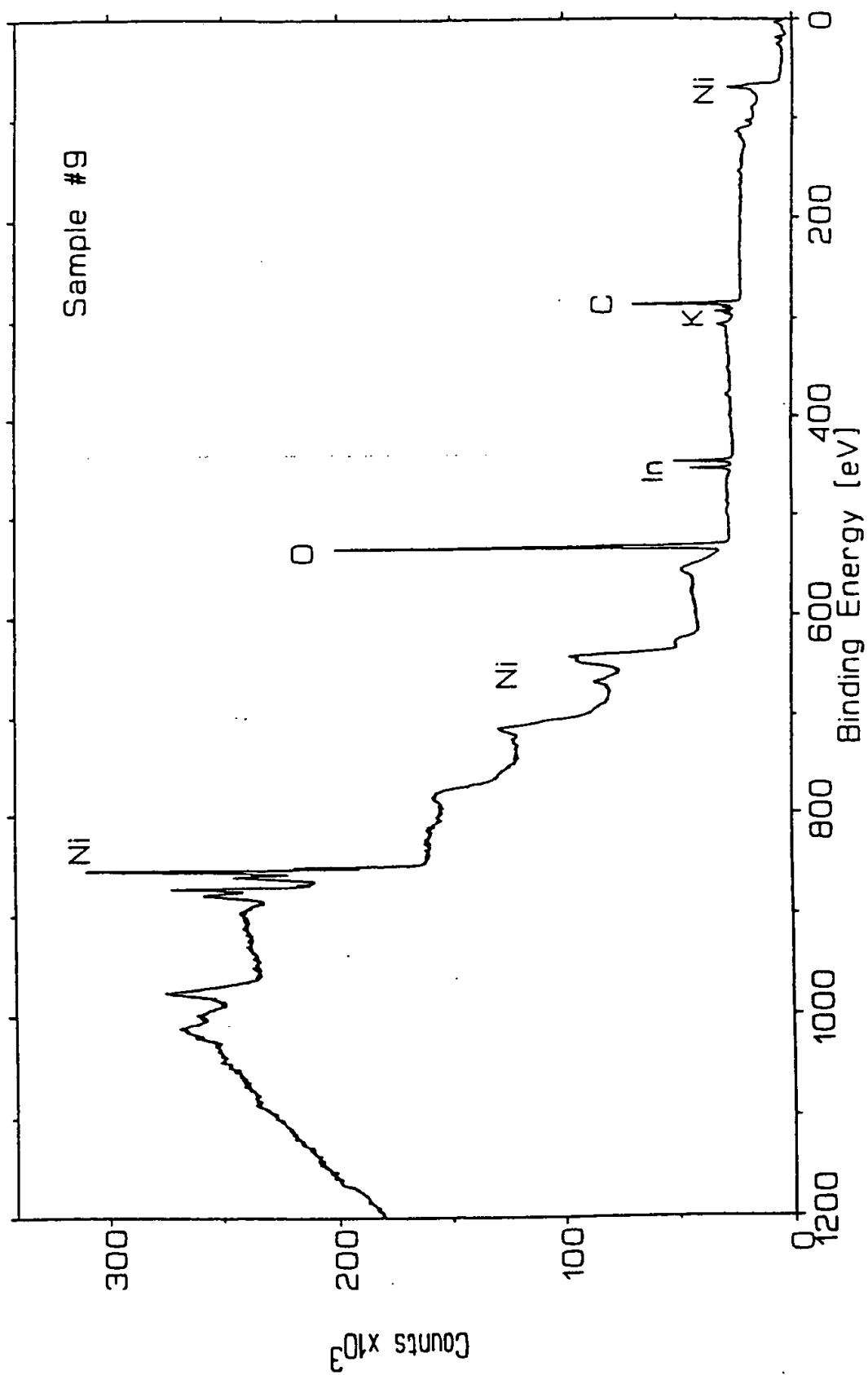
HPCK-09.003
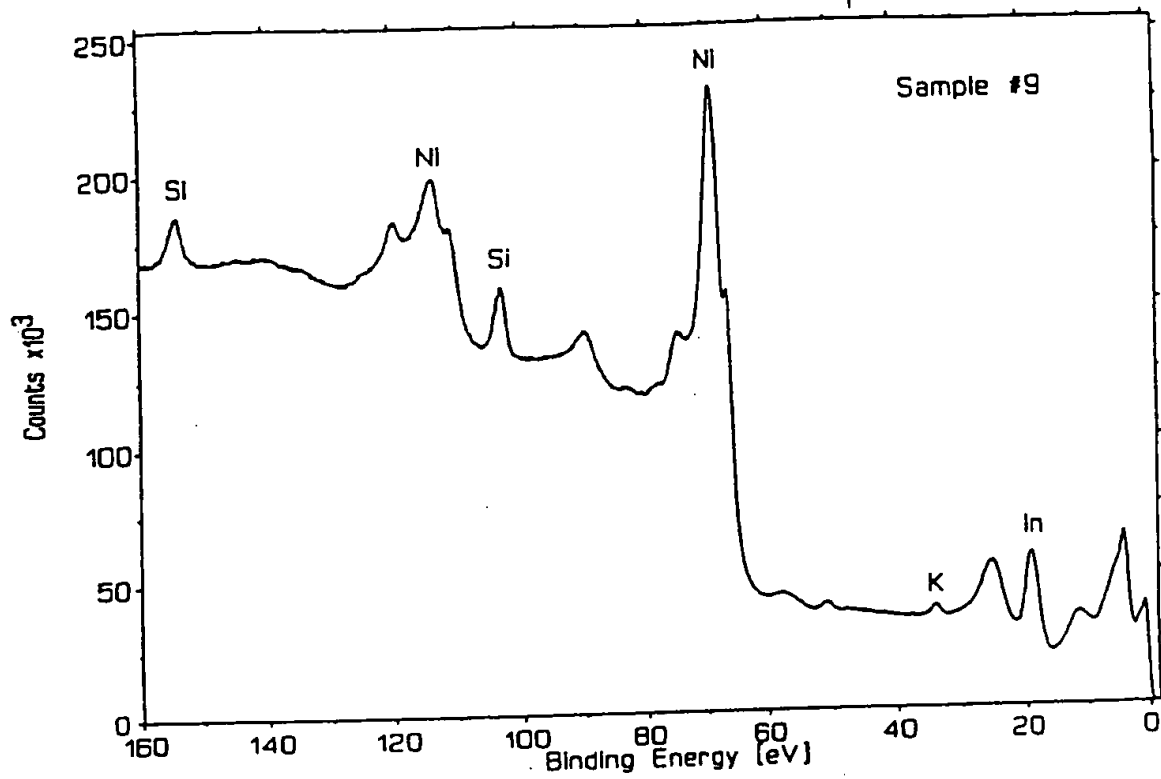
Figure 22

HPCK-09.003

HPCK-08.003

Figure 23

Sample #10
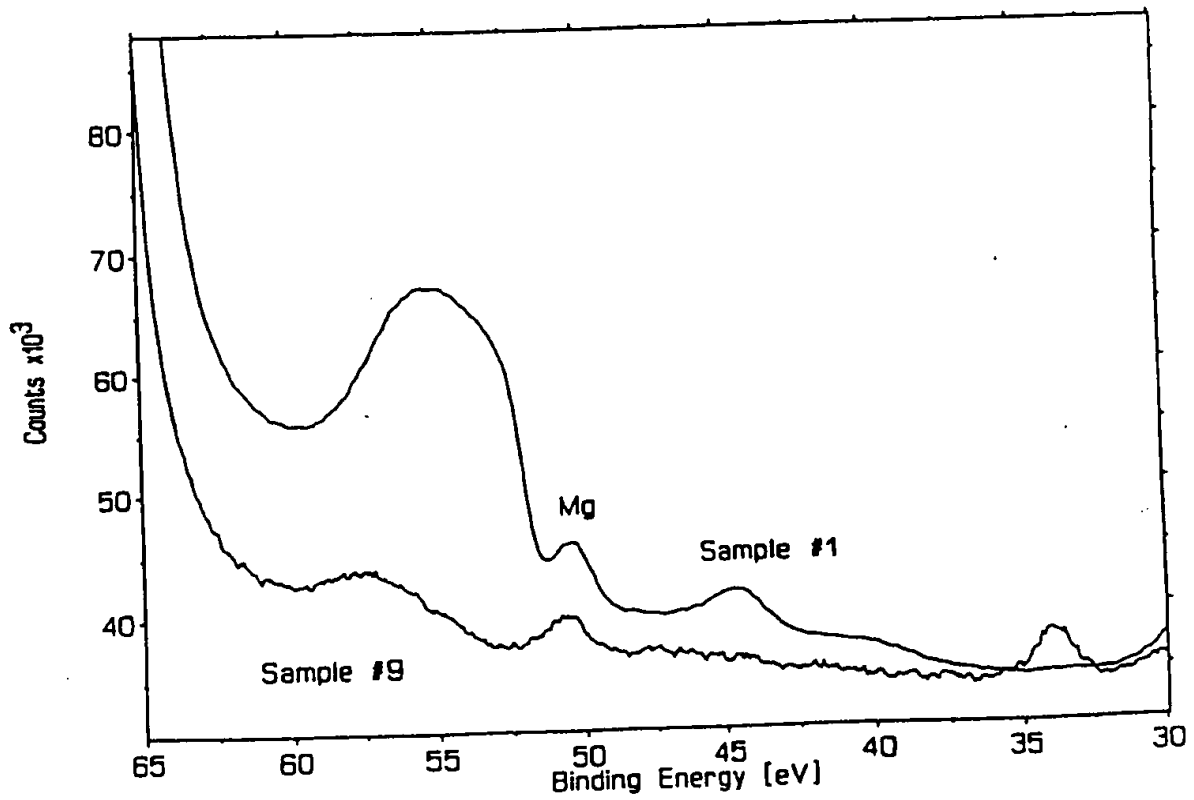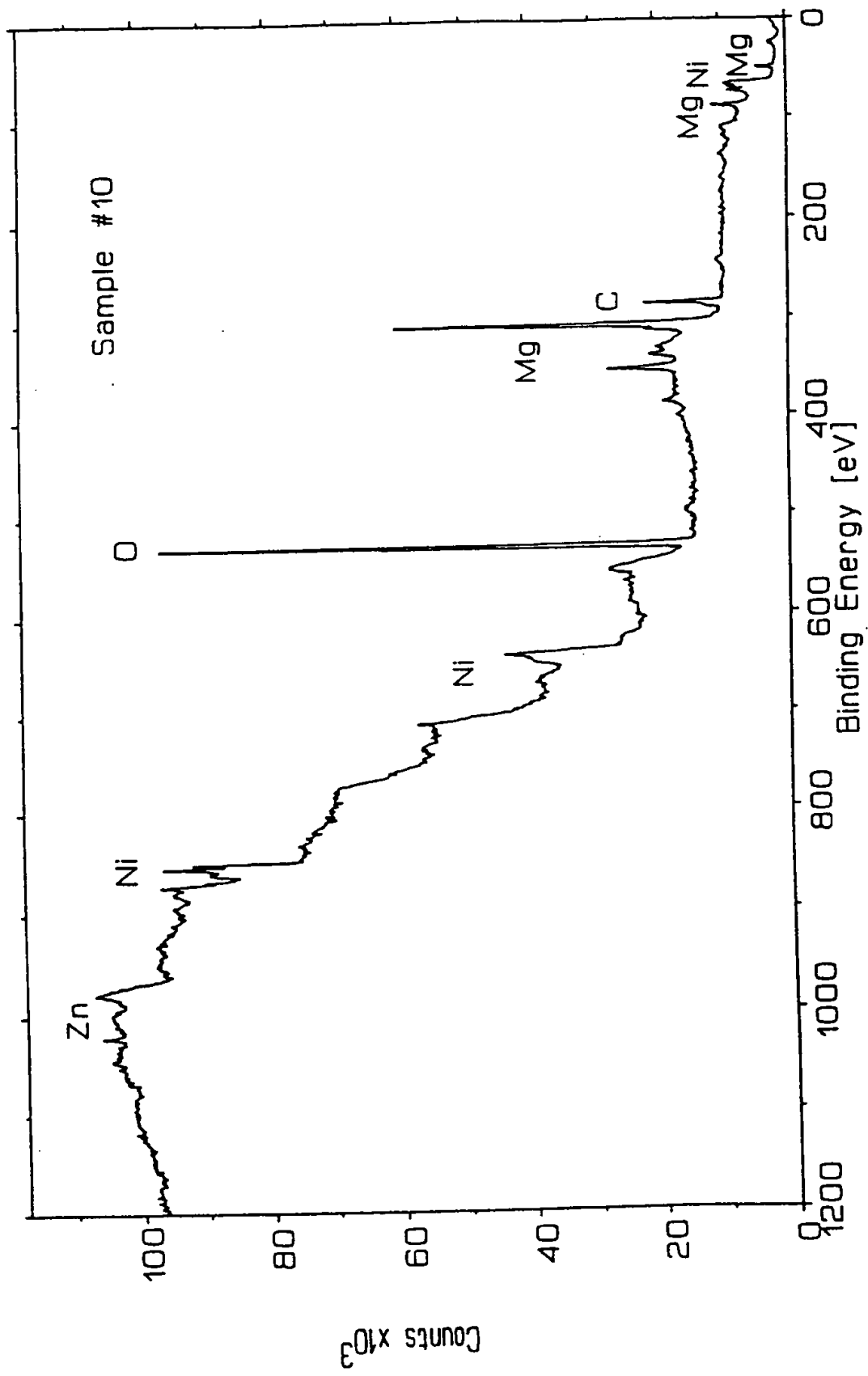
HPCNA-01.001

Figure 24

Sample #10

HPCNA-01.002

Sample #10
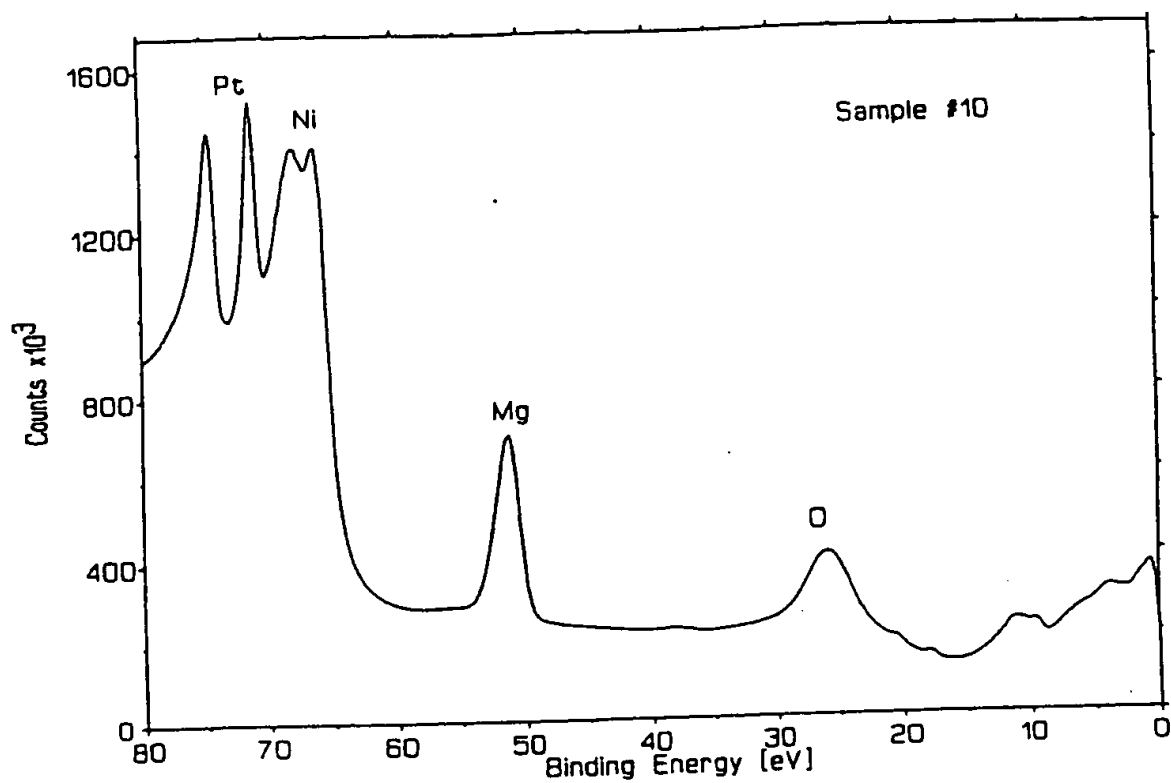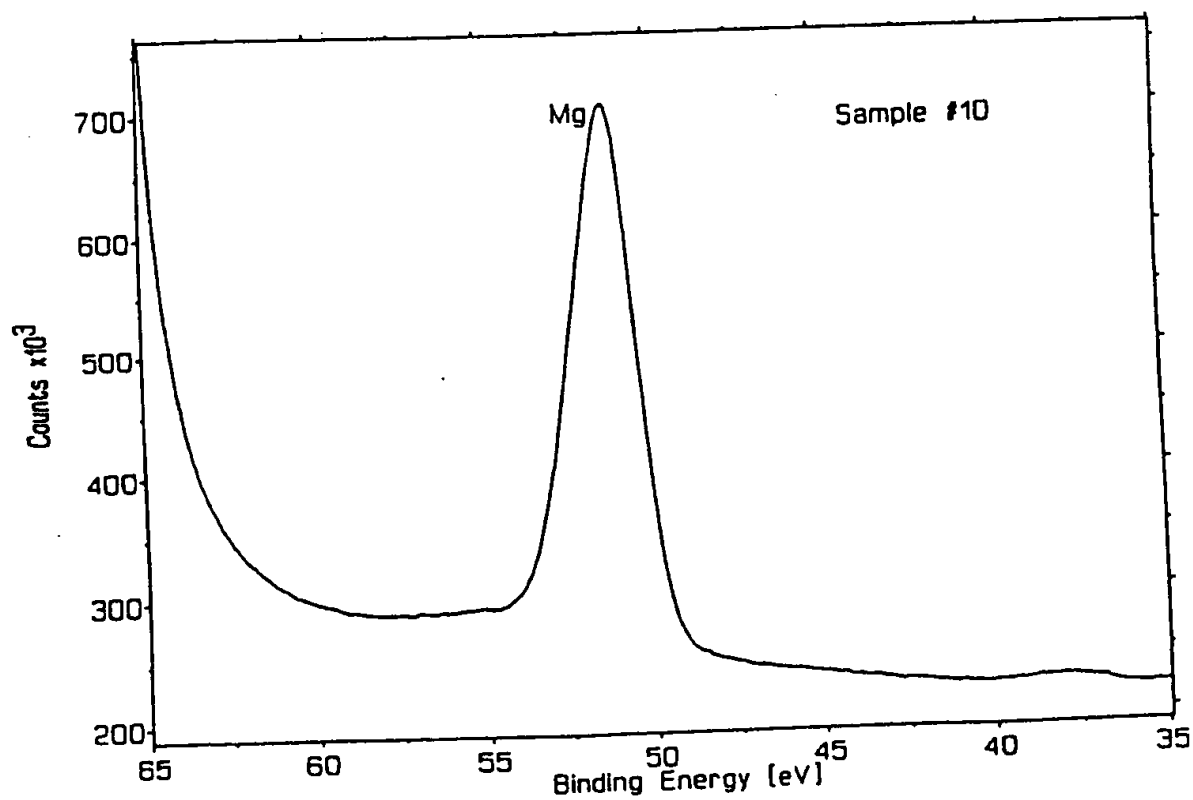
HPCNA-01.002

Figure 25
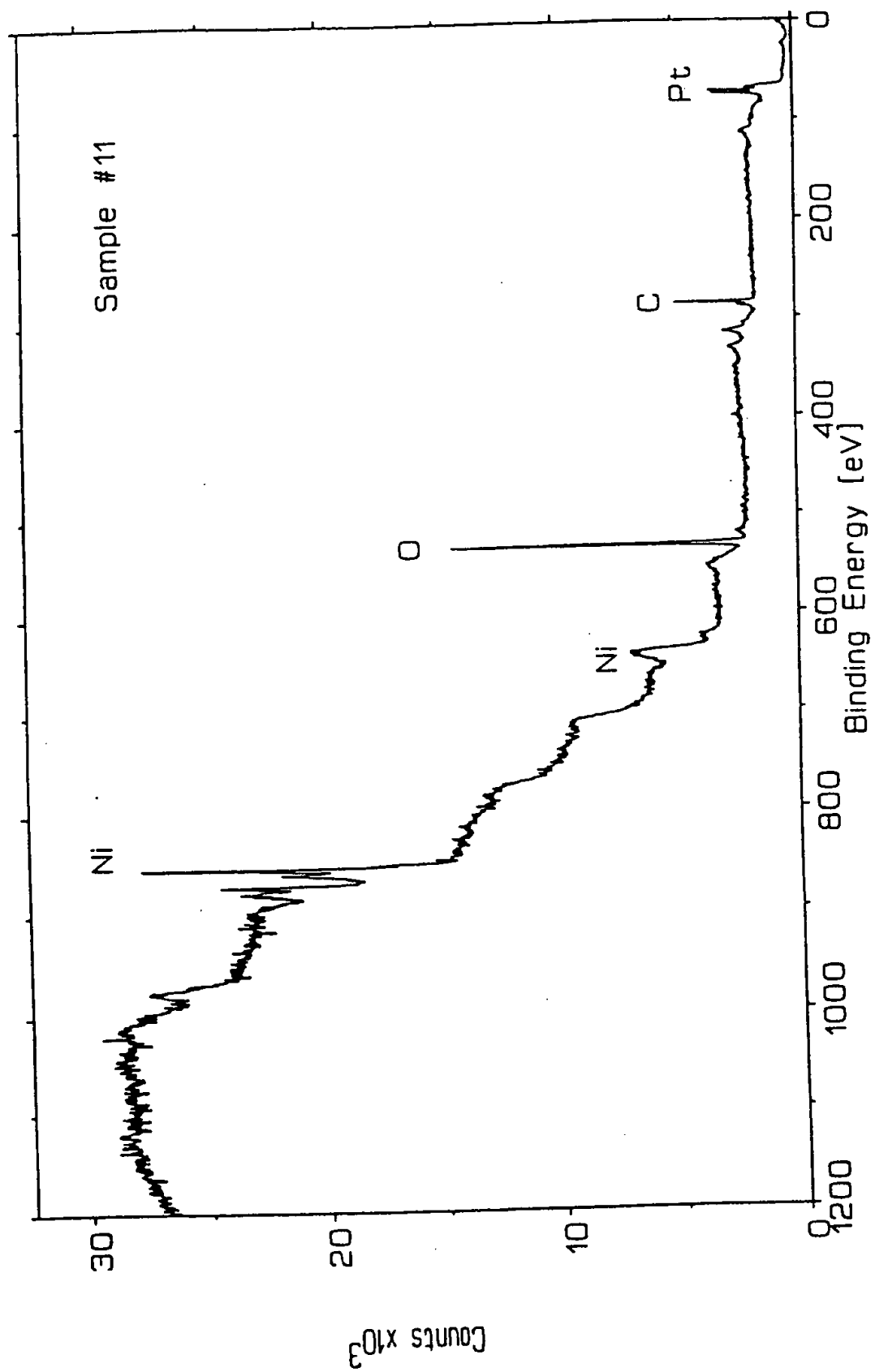
HPCNA-02.001

Figure 26
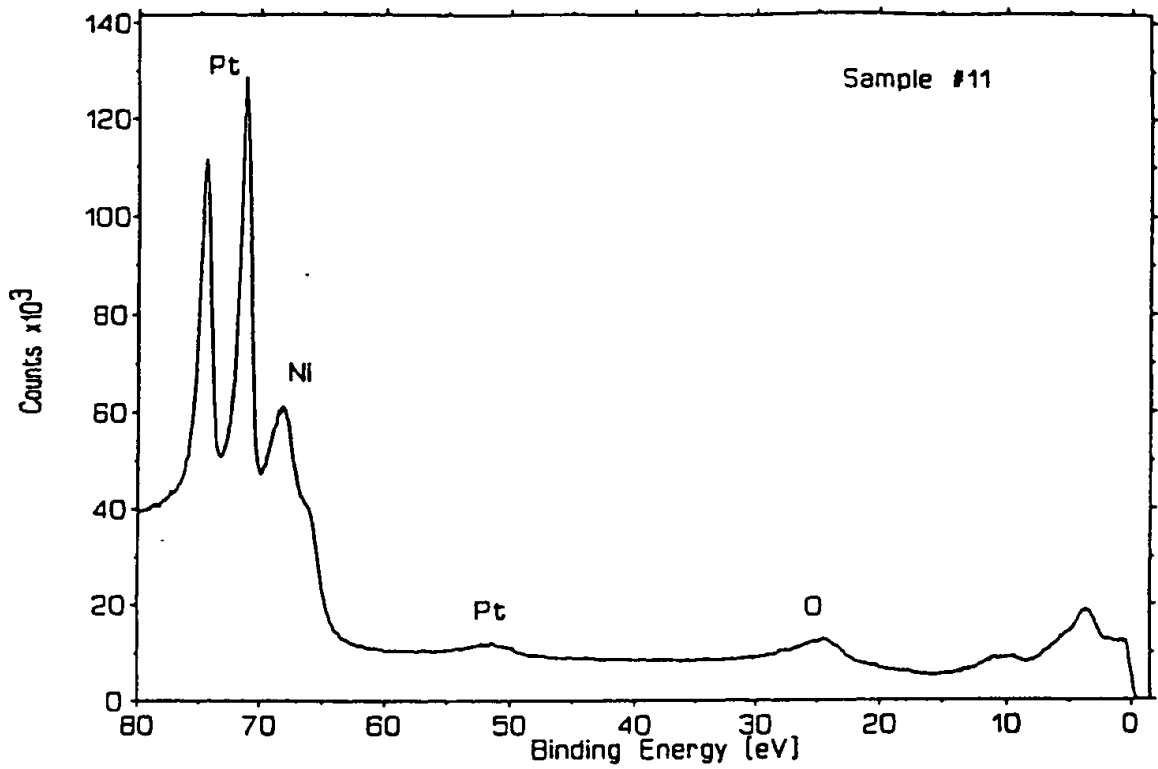
HPCNA-02.002
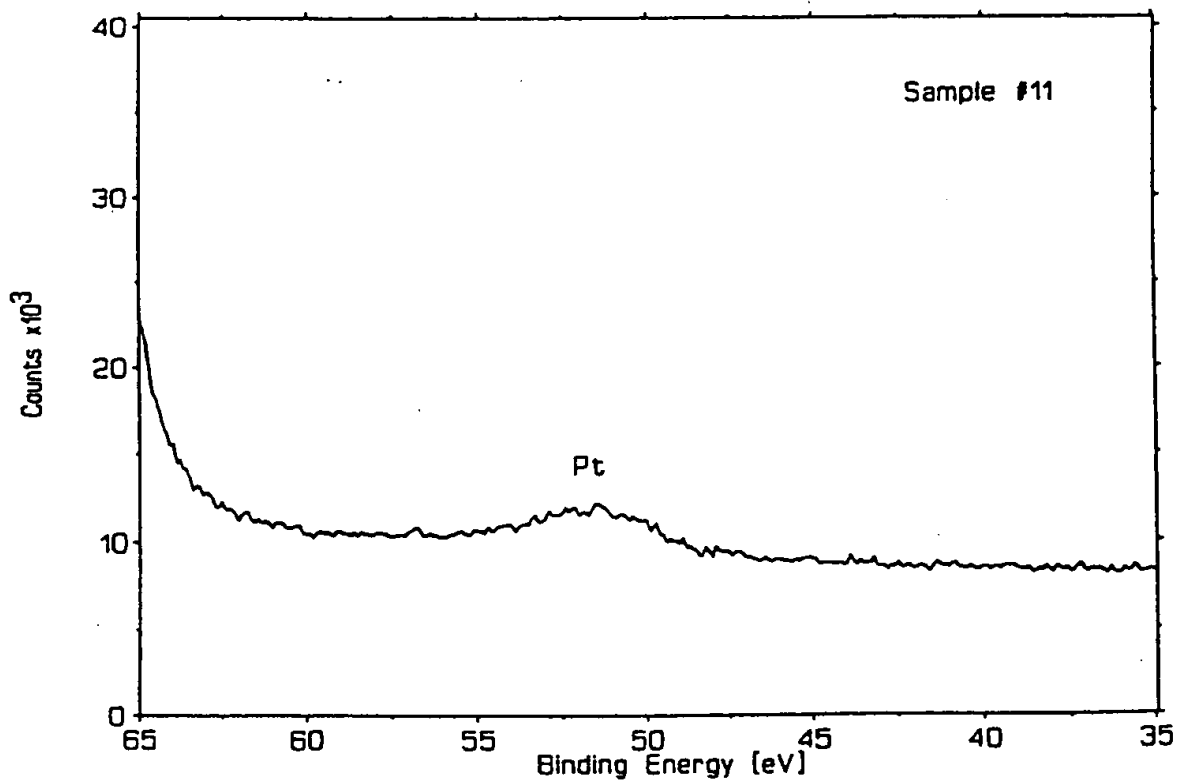
HPCNA-02.002

Figure 27
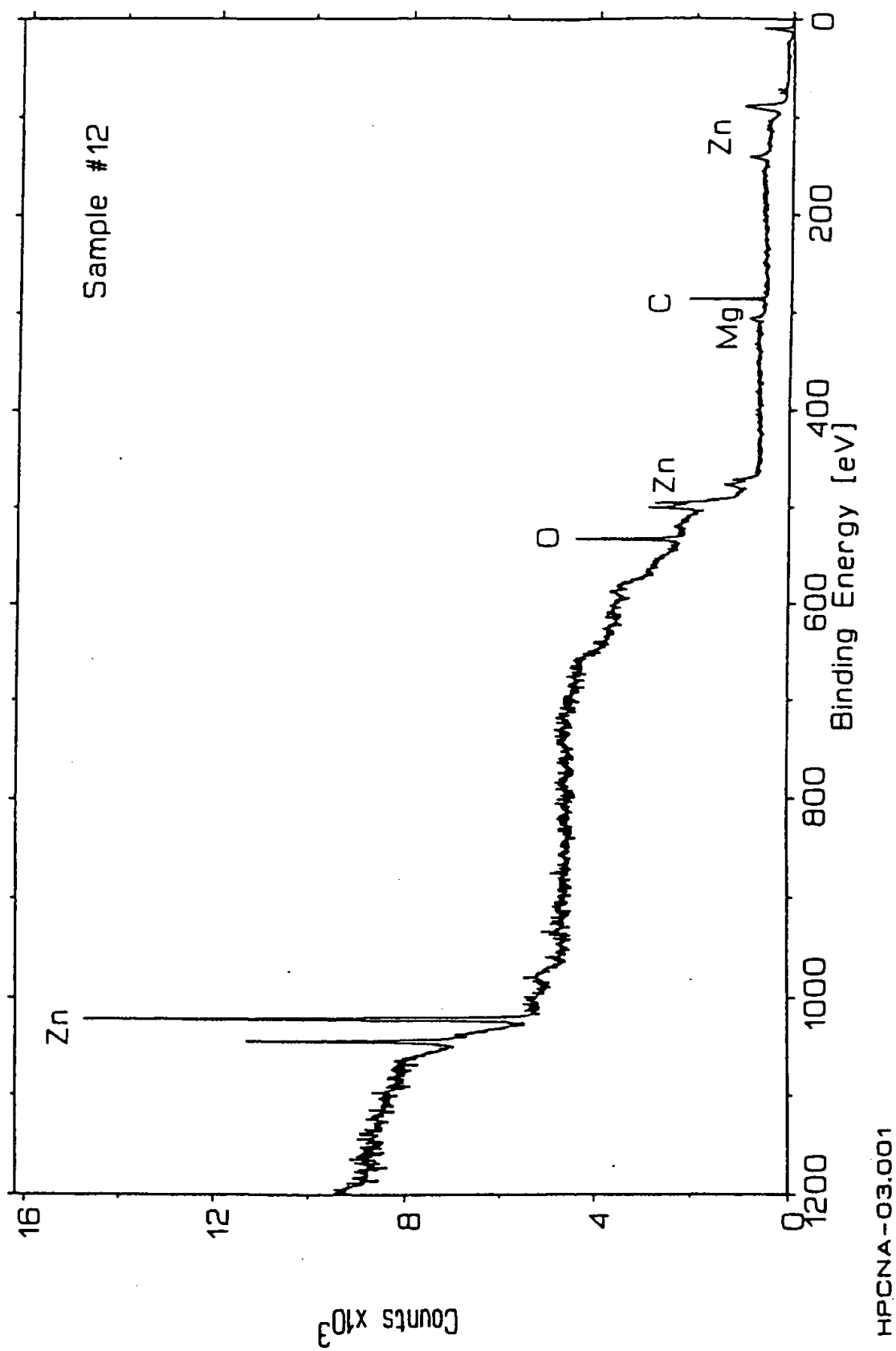
Figure 28
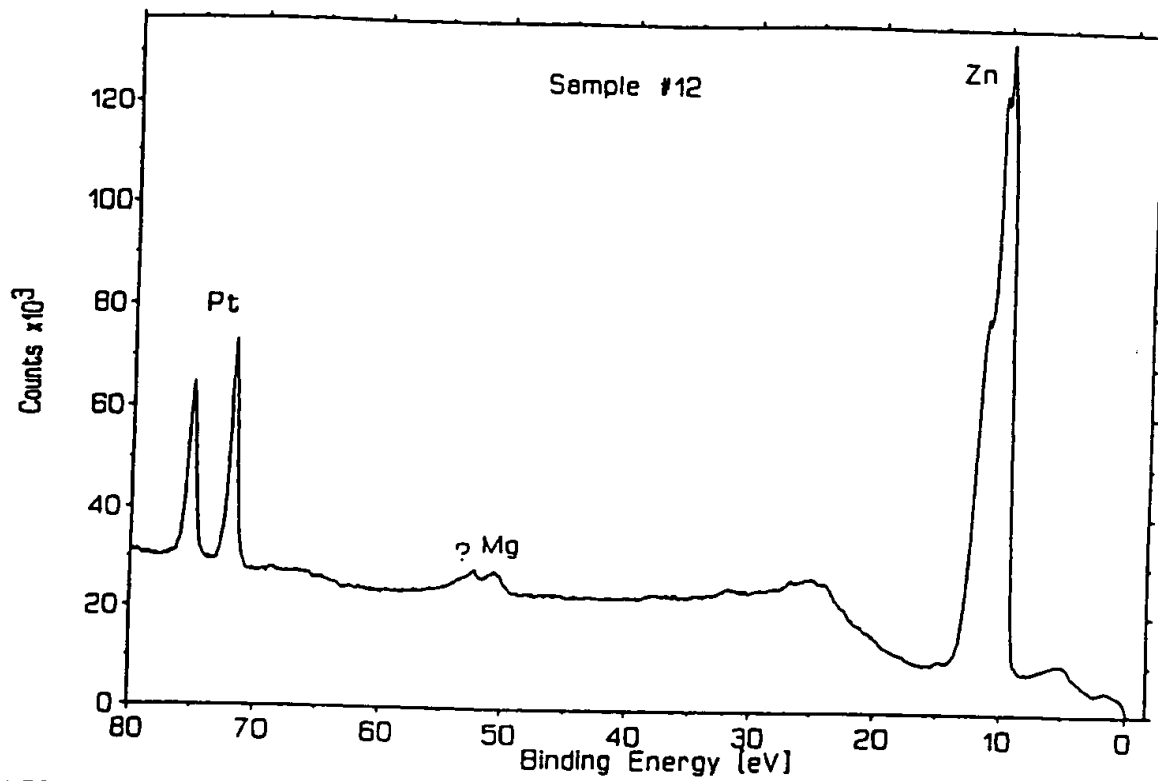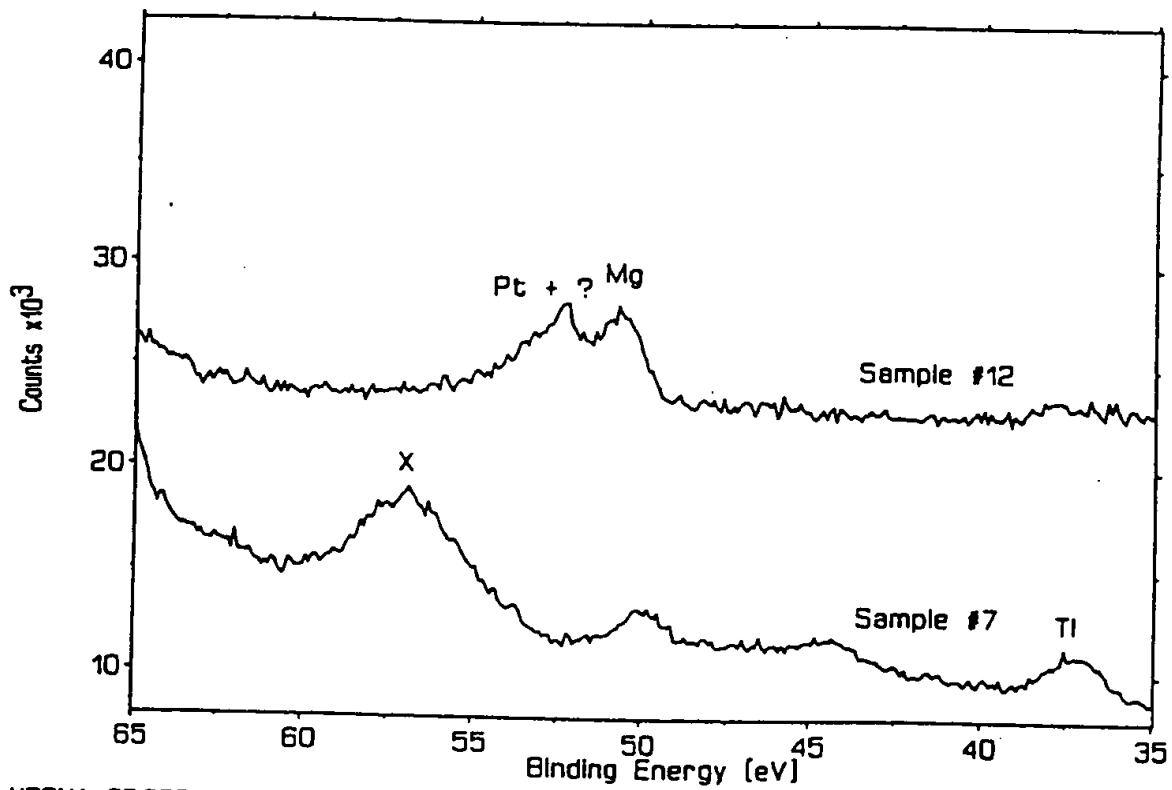
Figure 29

Sample #13

Pt

Pt

C

Sn

O

Ni

Ni

Binding Energy [eV]

Counts x10³

300

200

100

0   200   400   600   800   1000   1200

HPCNA-04.002

Figure 30

Sample #13

Pt

Ni   Pt

O

HPCNA-04.002

Sample #13

Pt

HPCNA-04.002

Figure 31

Sample #14

Counts x10³

Binding Energy [eV]

Ni

C

O

Ni

Ni
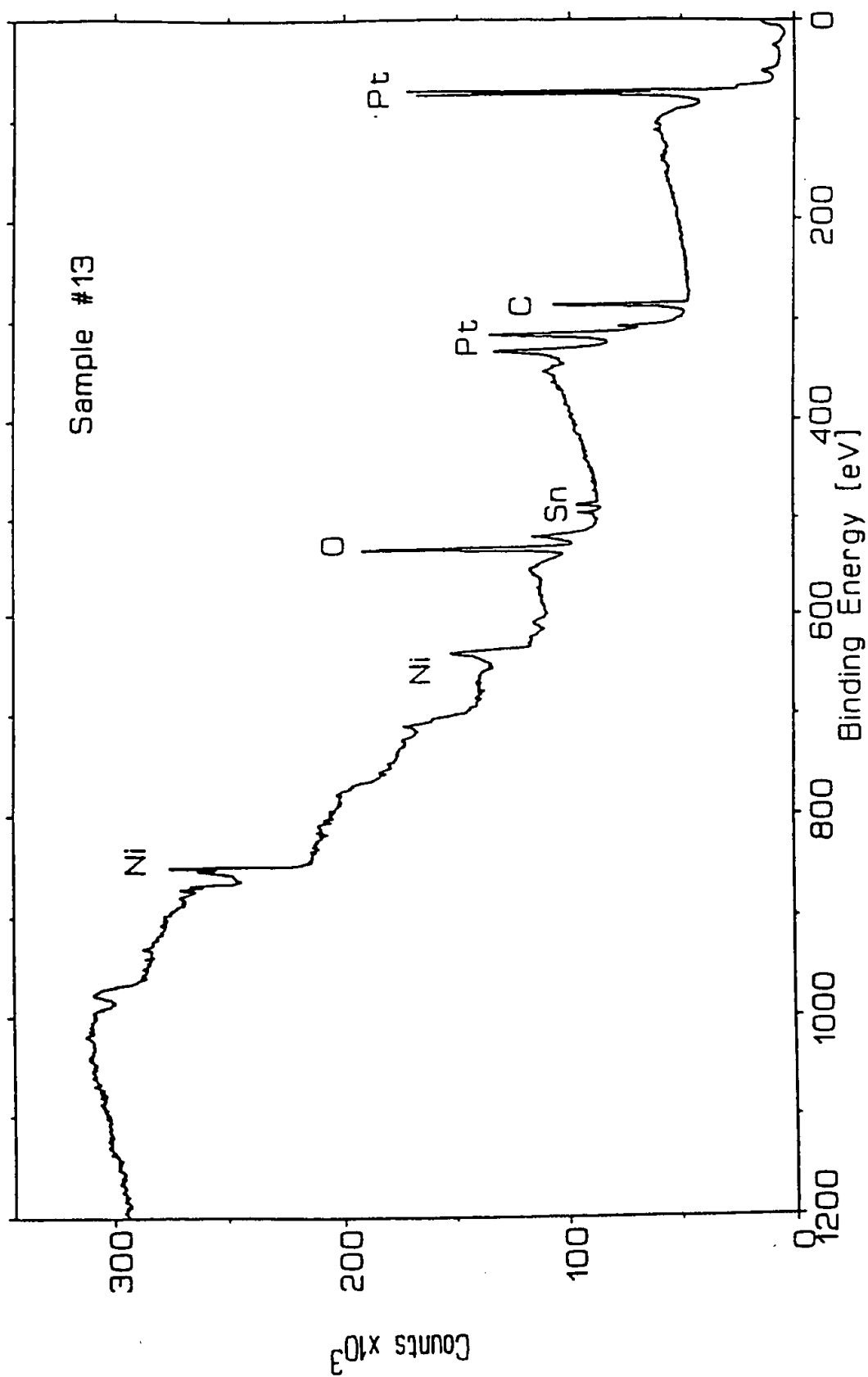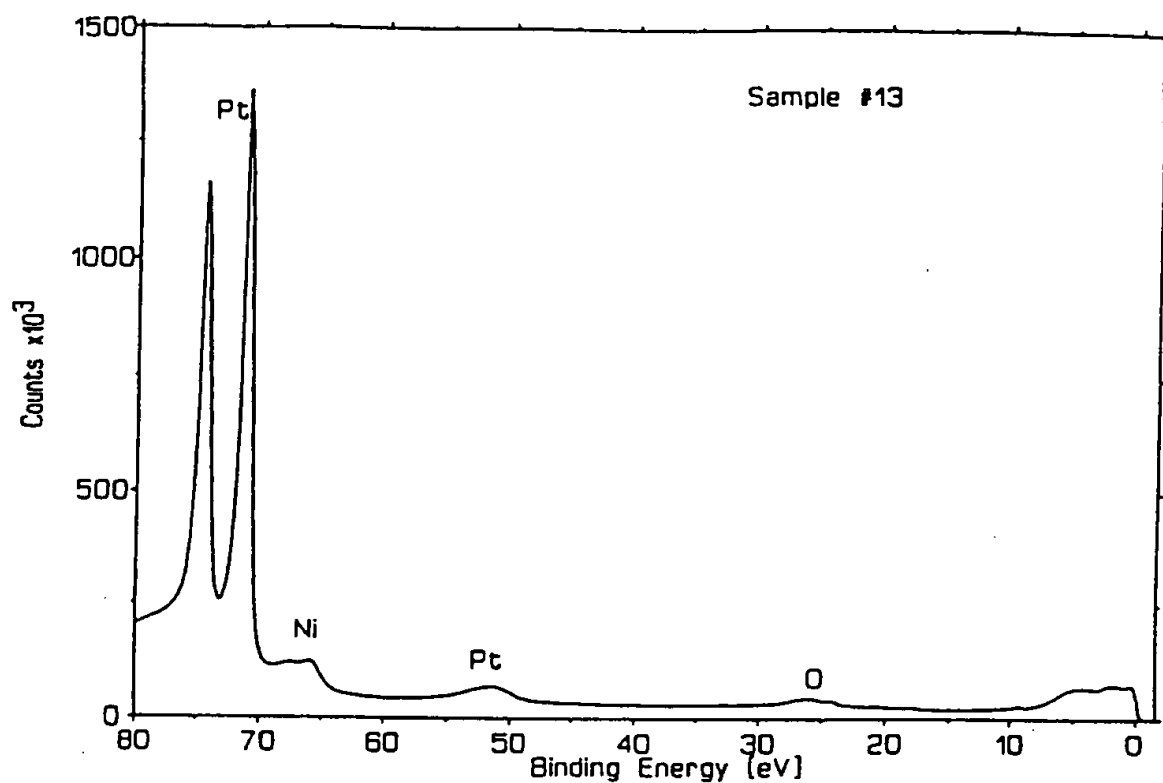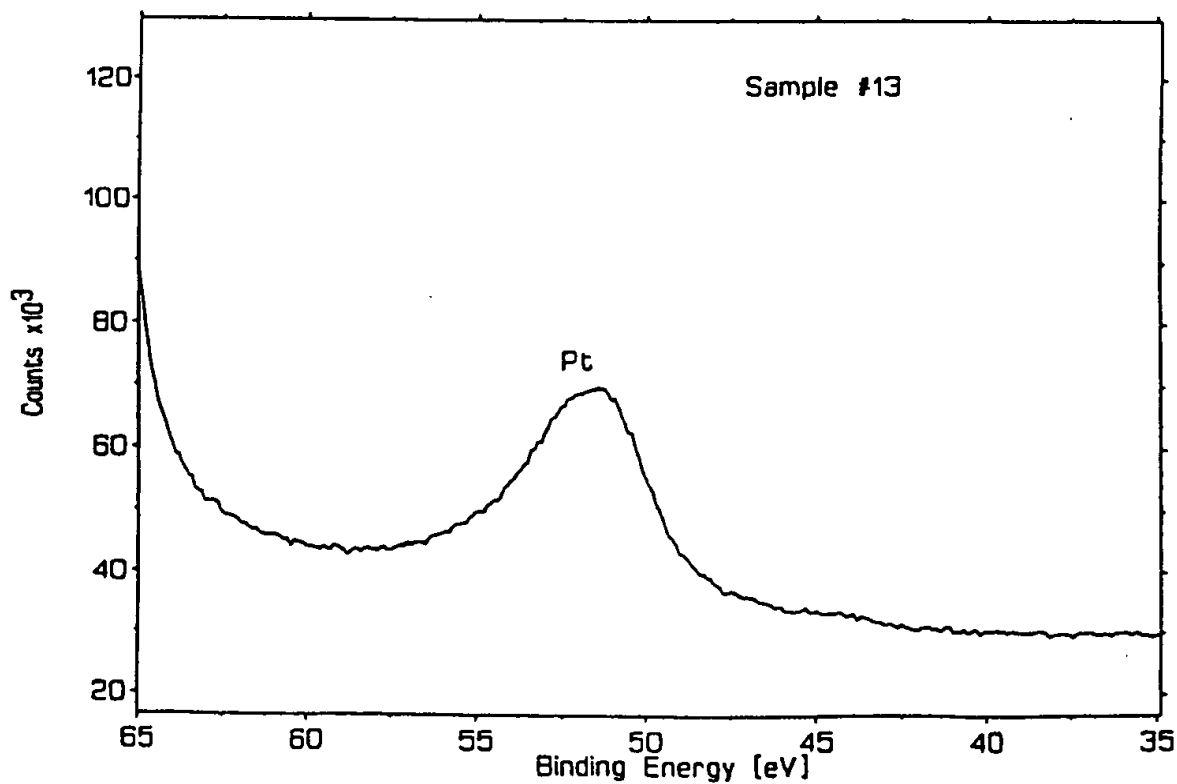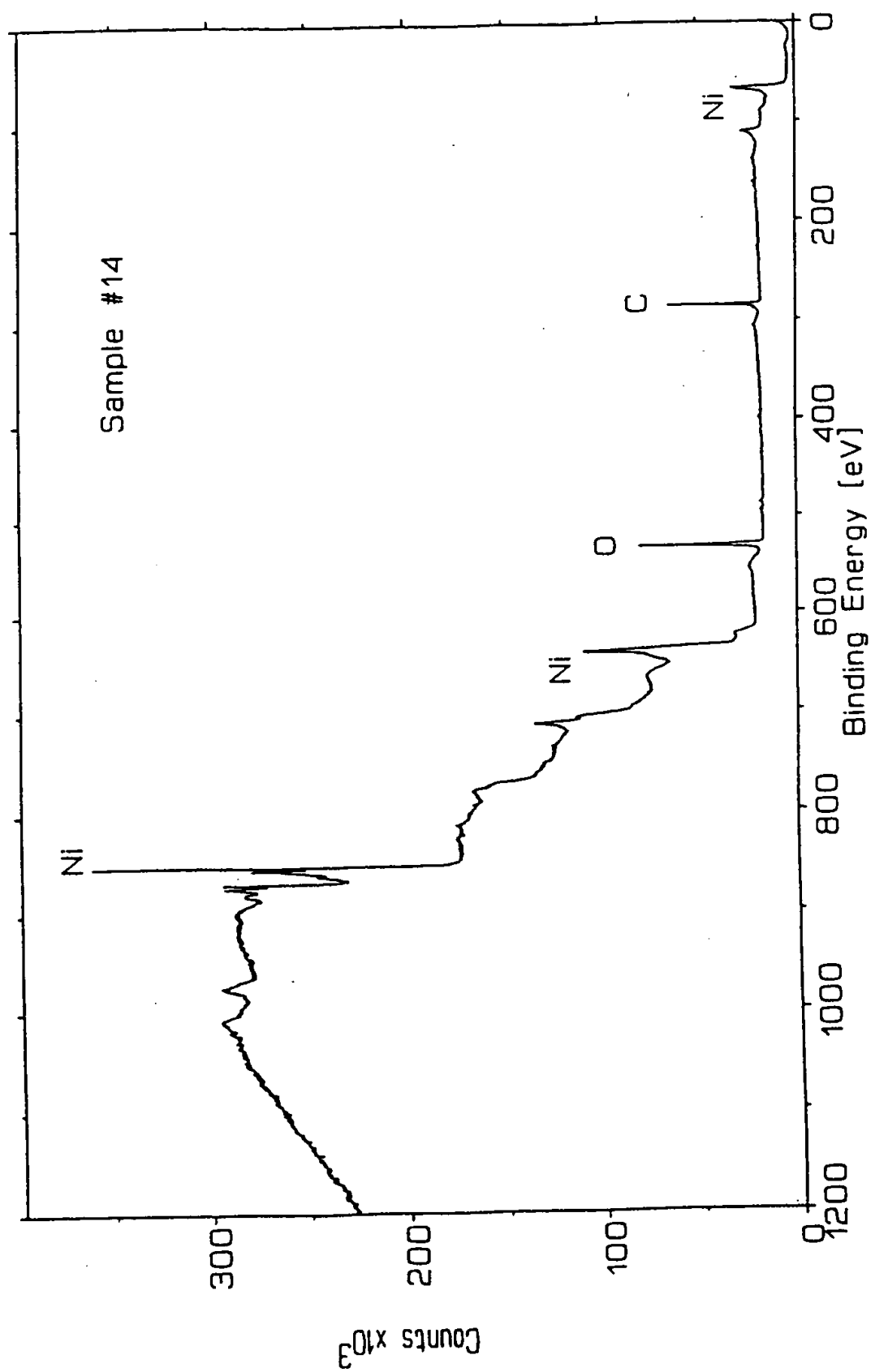
HPCNA-05.004

Figure 32

Sample #14

HPCNA-05.003

Sample #14
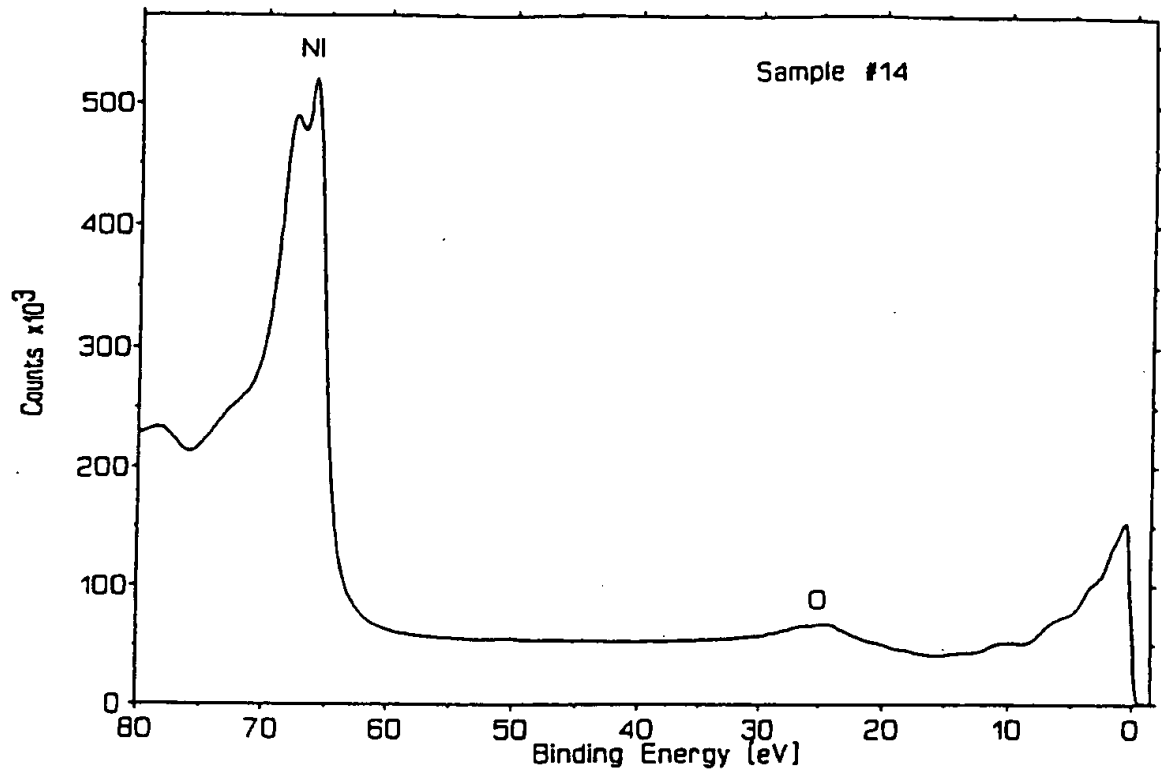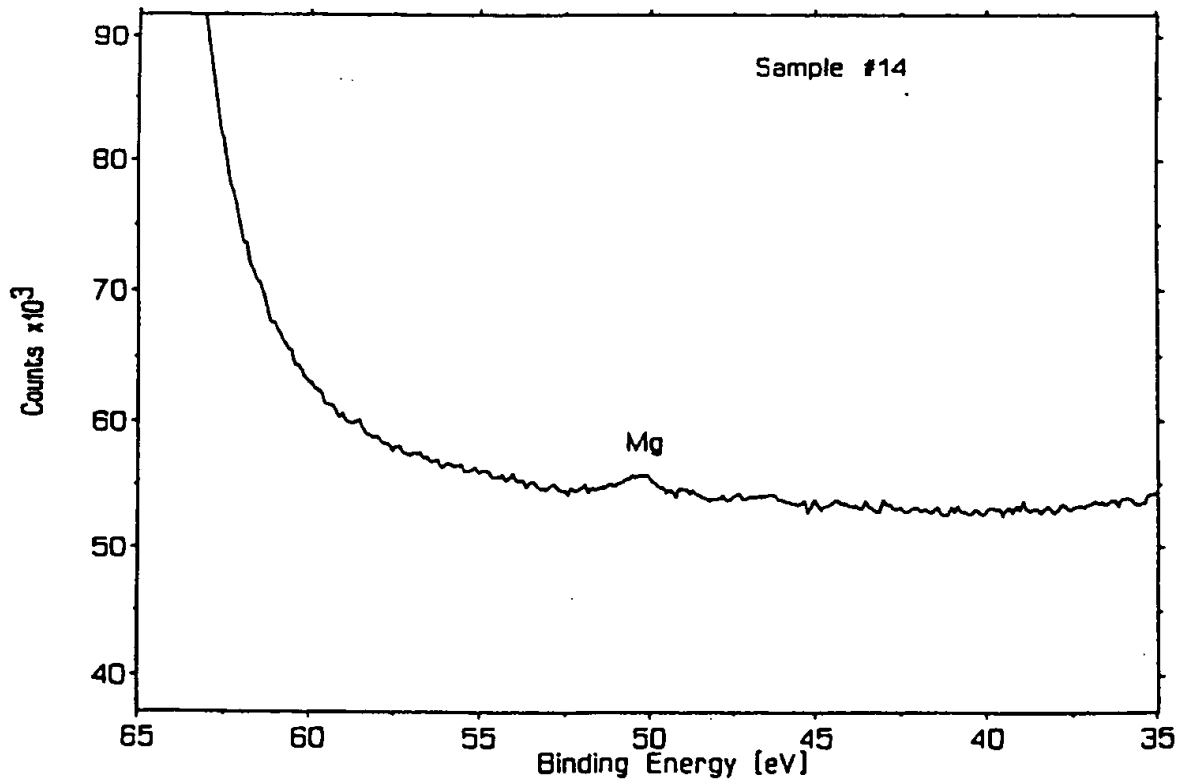
HPCNA-05.003

Figure 35
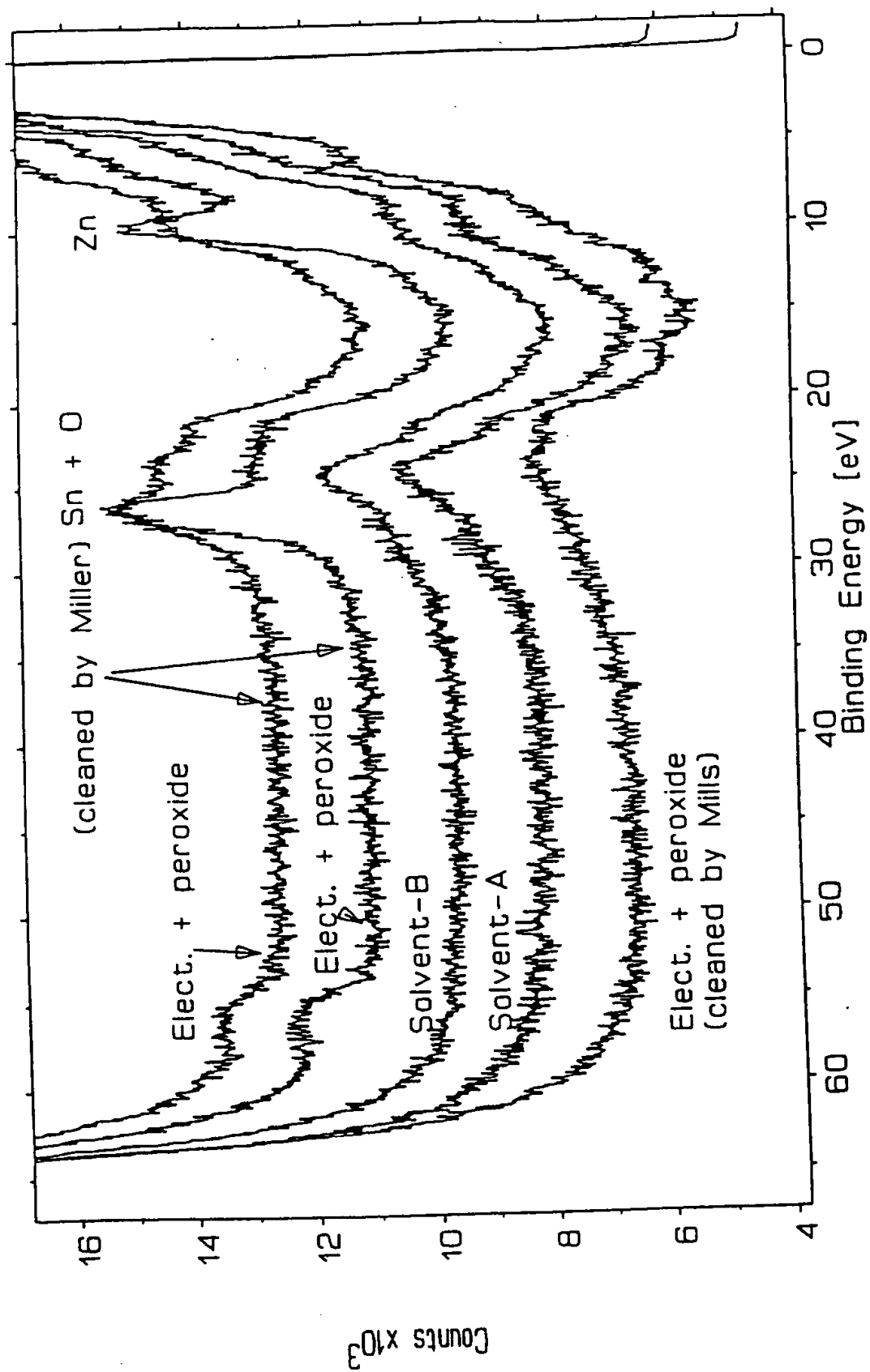
Figure 33
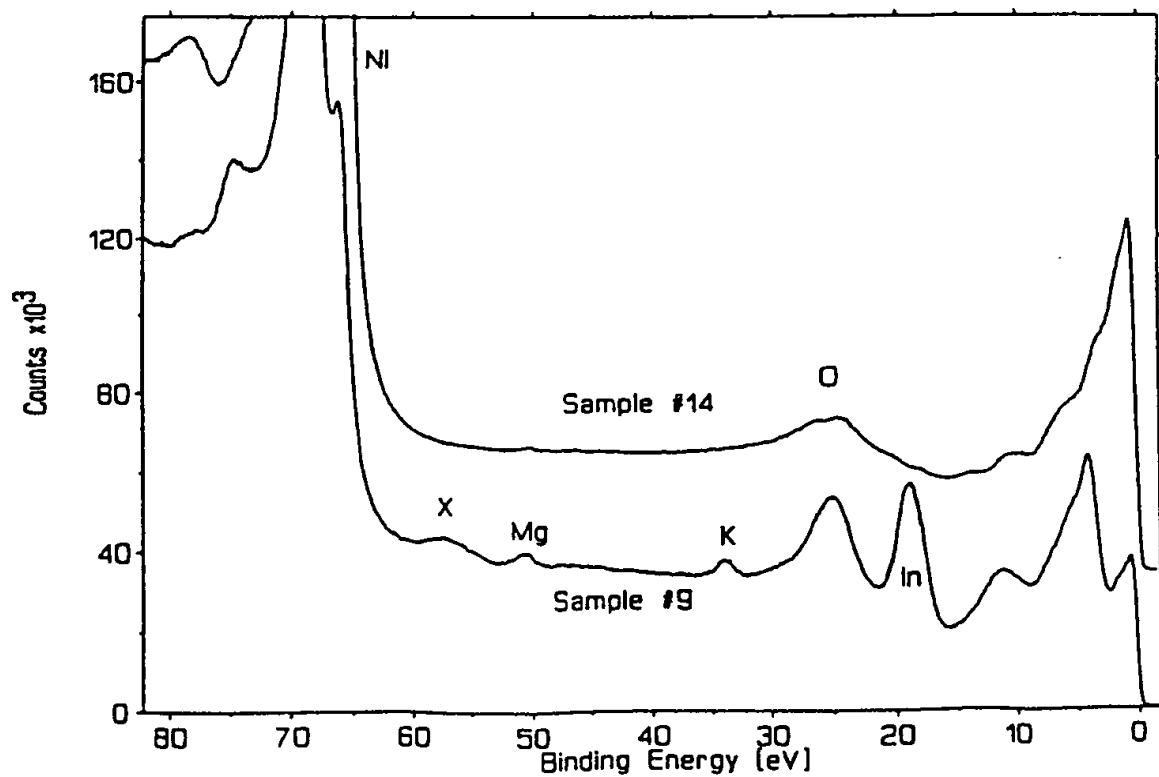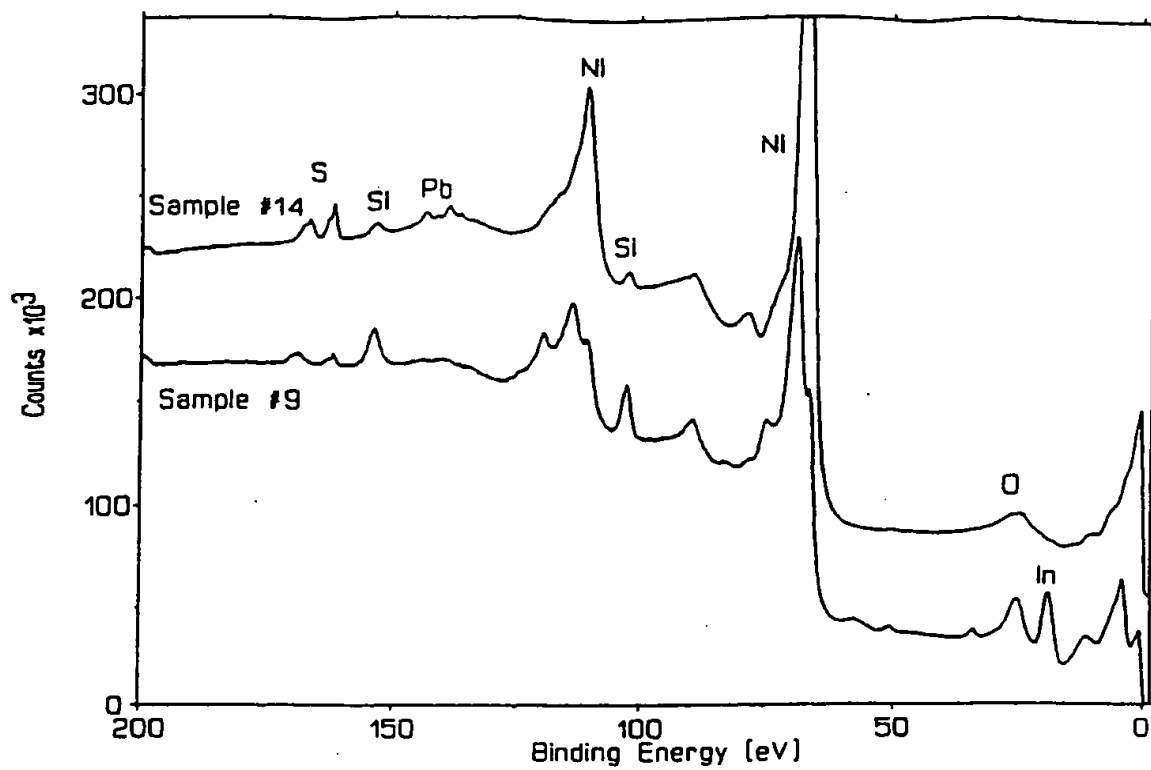
Figure 34
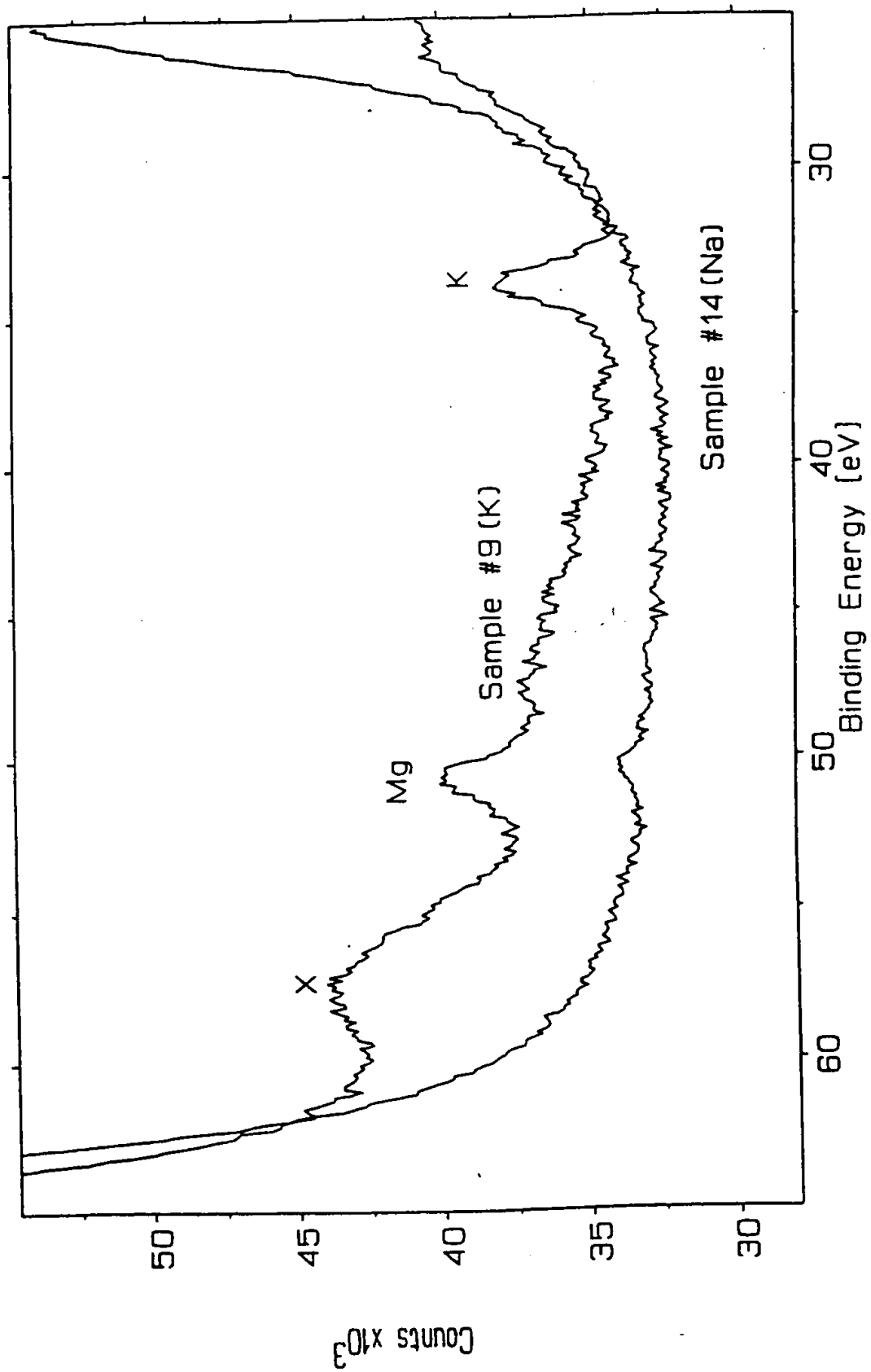
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Jacox, M. G., Watts, K. D., "INEL XPS Report", Idaho
National Engineering Laboratory, EG&G Idaho, Inc.,
Idaho Falls, Idaho, 83415, November 1993

All Data Displayed (No Peak Picking)

C:\MASSDEMODATA\111883A.DAT
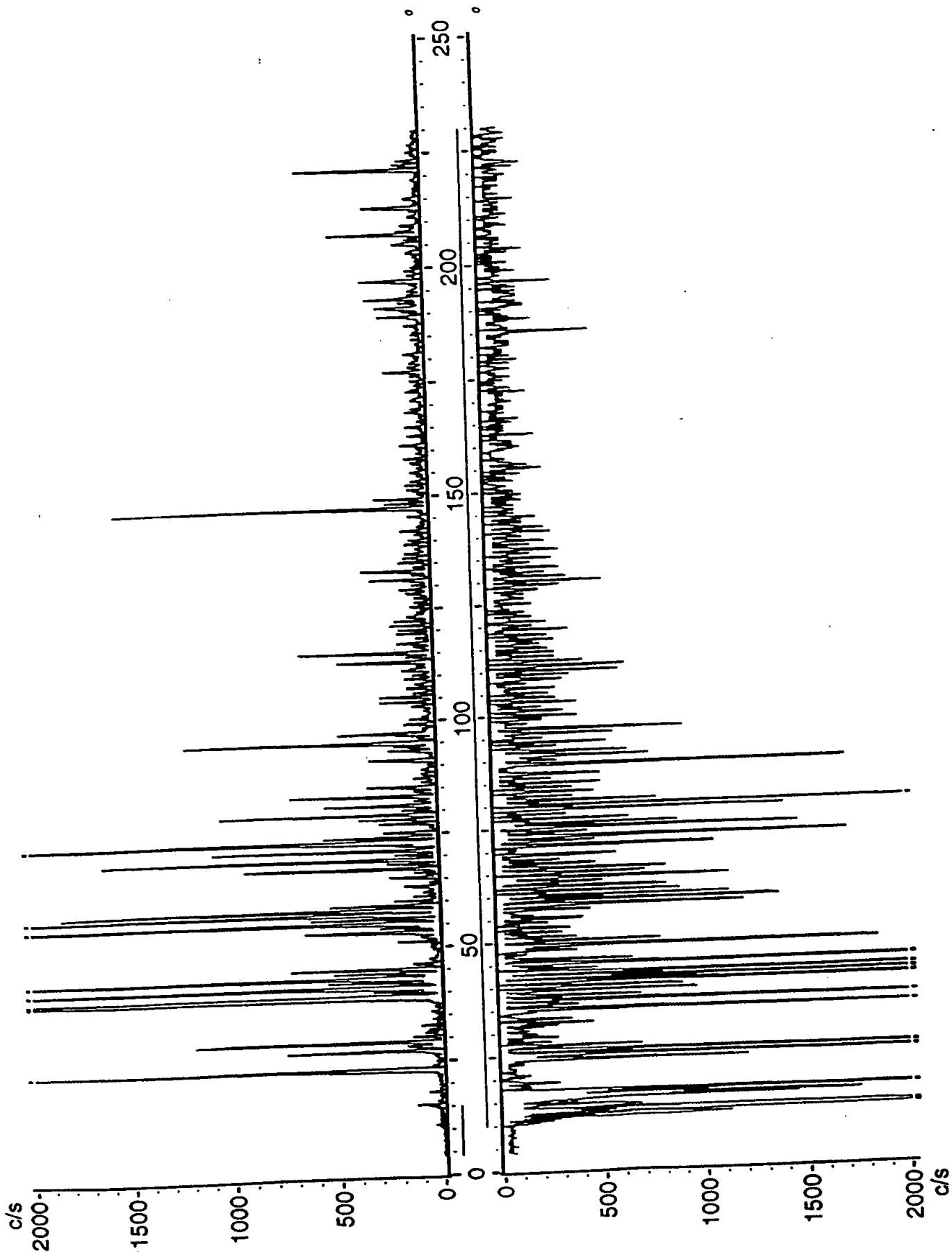
Record: 1

C:\MASSDEMODATA\111883B.DAT

Record: 1

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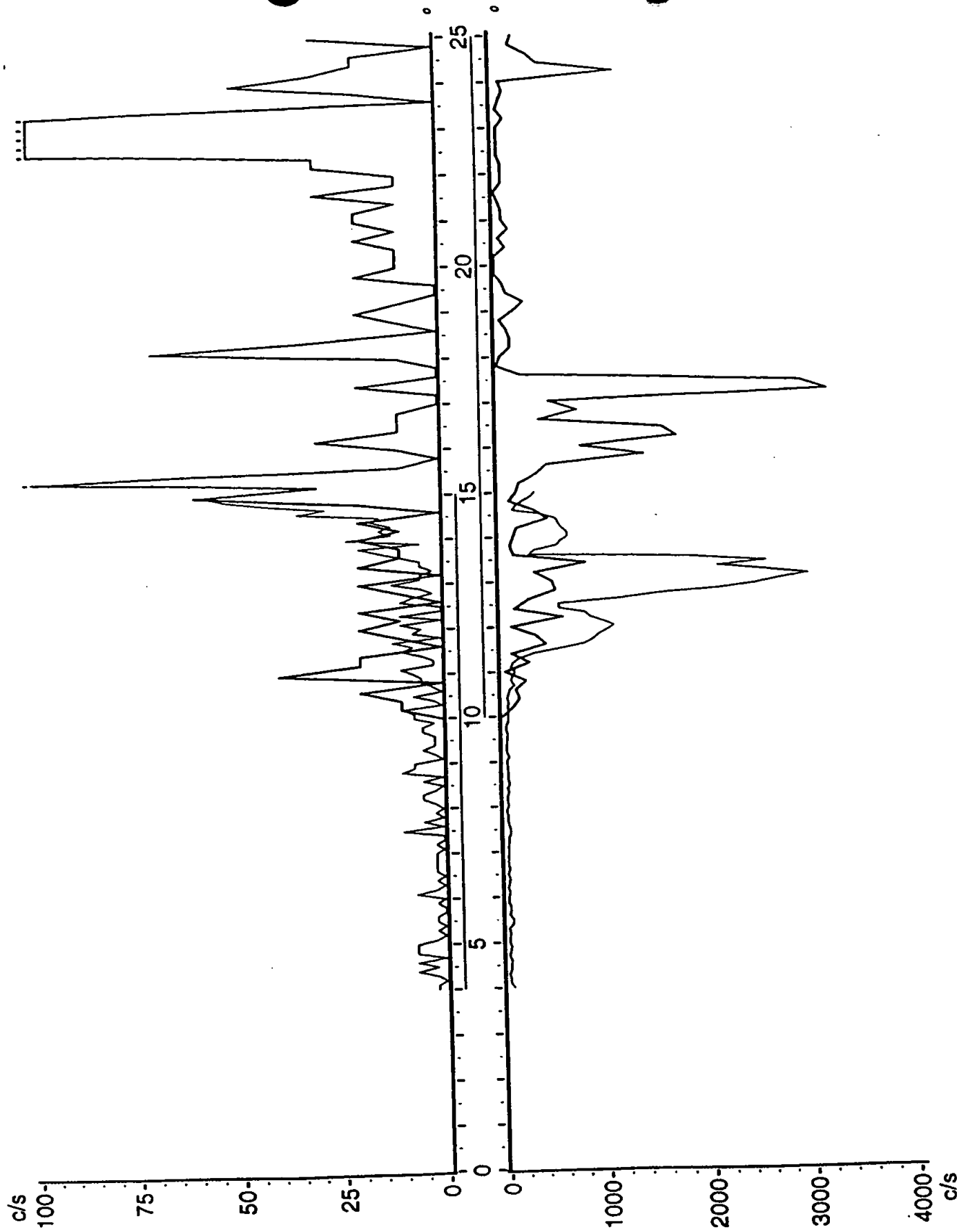
08:87:30 11/18/1983 08:37:38

c/s

All Data Displayed (No Peak Finding)
Wire - November 18, 1993

100- c/s
75-
50-
25-
0-

0
1000-
2000-
3000-
4000- c/s

5   10   15   20   25

Cursor

Energy (eV)   54.700   28178 Counts   1445 Counts/Sec

N(E)/E.sat.Shf

BINDING ENERGY, eV

ESCA MULTIPLEX   11/24/93   EL= REG 2   ANGLE= 15 deg   ACQ TIME=114.08 min

FILE: Nitest50   Ni wire treated overnight at IRC.

SCALE FACTOR= 0.116 k c/s,   OFFSET= 1.036 k c/s   PASS ENERGY=143.050 eV   Al   400 W

BINDING ENERGY, eV

N(E)/E, sat.shf
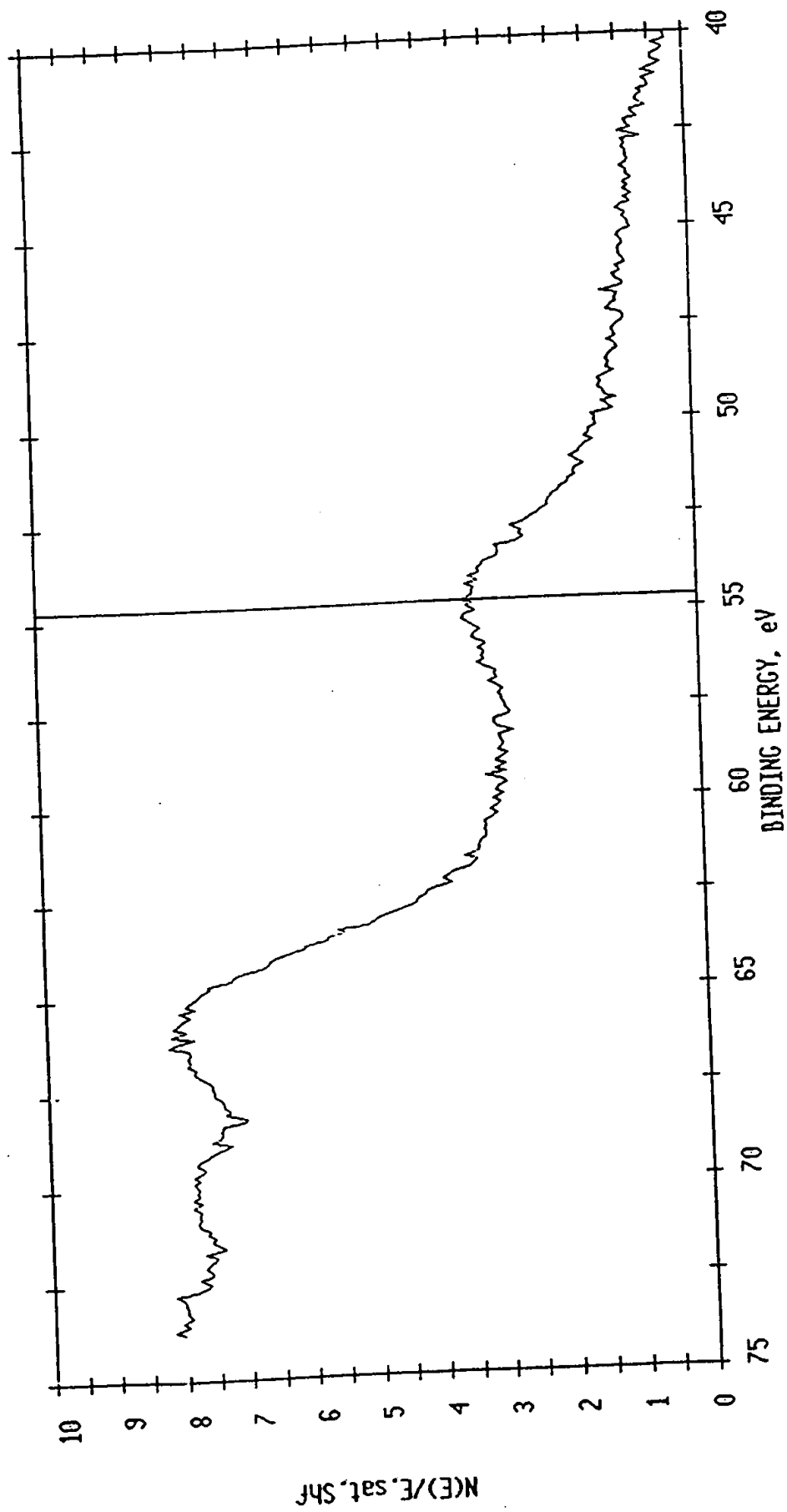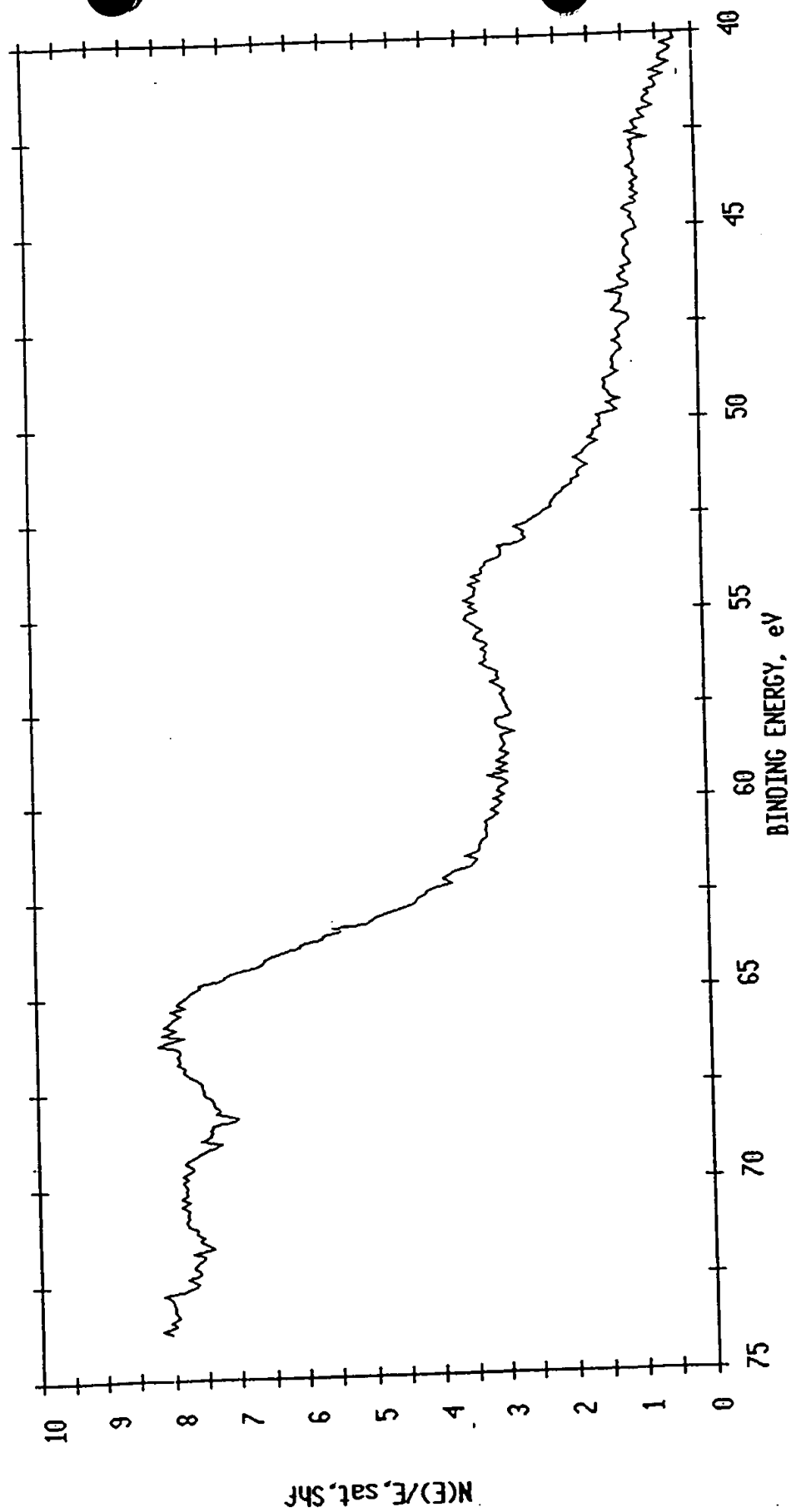
ESCA MULTIPLEX 11/22/93 EL= REG 2 ANGLE= 15 deg ACO TIME=96.53 min
FILE: Nitest32 2nd Ni wire treated prior to IRC.
SCALE FACTOR= 0.274 k c/s, OFFSET= 1.580 k c/s PASS ENERGY=143.050 eV Al 400 W

BINDING ENERGY, eV

N(E)/E,sat

ESCA MULTIPLEX 11/18/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=76.05 min
FILE: Nitest22 Ni foil untreated. as received.
SCALE FACTOR= 3.401 k c/s, OFFSET= 9.545 k c/s PASS ENERGY=143.050 eV Al 400 W

Processed Ni wire and unprocessed Ni foil.

N(E)/E, sat, shf

BINDING ENERGY, eV

ESCA MULTIPLEX   11/19/93   EL= REG 2   ANGLE= 15 deg   ACQ TIME=84.83 min
FILE: Nitest25   Ni foil treated in lab for 24 hr. As received.
SCALE FACTOR= 1.920 k c/s,   OFFSET= 8.515 k c/s   PASS ENERGY=143.050 eV   Al   400 W

Ni foils before and after treatment.

N(E)/E,sat

BINDING ENERGY, eV

40   45   50   55   60   65   70   75

10   9   8   7   6   5   4   3   2   1   0

ESCA MULTIPLEX 11/18/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=67.28 min
FILE: Nitest20 Ni wire processed in lab. as received.
SCALE FACTOR= 0.331 k c/s, OFFSET= 2.436 k c/s PASS ENERGY=143.050 eV Al 400 W

Treated and untreated Ni wire

BINDING ENERGY, eV

N(E)/E,sat,Shf

ESCA MULTIPLEX   11/19/93   EL= REG 2   ANGLE= 15 deg   ACQ TIME=61.43 min

FILE: Nitest27   Ni wire untreated (base line) using Al X-Ray's.

SCALE FACTOR= 0.326 k c/s,   OFFSET= 1.491 k c/s   PASS ENERGY=143.050 eV   Al   400 W

N(E)/E,sat,Shf

BINDING ENERGY, eV

Figure 4.13

O 2s

Ni 3p

2.5.17
2.7

Al
Mg

Ni 3s
Pb
Zr
Si
Mg 2s
Ni 2s
Pb
S si
K
Na

Binding Energy [eV]

Counts x10³

Several examples of different energy holes effecting shrinkage and the corresponding effective nuclear charges, total energy released, and final radii of the orbitspheres going from infinity to the final radius, $a_0/(m+1)$ are given in Table 20.1.

Table 20.1.   Radii, energies, energy holes, and energy released for several states of hydrogen or deuterium.

n	R	V(eV)	T(eV)	Zeff	energy hole (eV)	total energy released (eV) $r = \infty$ to $r = R$
-	a_0	-27.2	13.6	1	-	13.6
1	$a_0/2$	-108.8	54.4	2	27.2	54.4
2	$a_0/3$	-244.9	122.4	3	54.4	122.4
3	$a_0/4$	-435.4	217.7	4	81.6	217.7
4	$a_0/5$	-680.2	340.1	5	108.8	340.1
5	$a_0/6$	-979.6	489.6	6	136.1	489.6
6	$a_0/7$	-1333.3	666.4	7	163.3	666.4
7	$a_0/8$	-1741.4	870.4	8	190.5	870.4
8	$a_0/9$	-2204.0	1101.6	9	217.7	1101.6
9	$a_0/10$	-2721.0	1360.5	10	244.9	1360.5

Energy released for any transition is given by ΔE final (∞ to R) - ΔE initial (∞ to R)

The size of the electron orbitsphere as a function of potential energy is given in Figure 20.2.

Figure 20.2. Quantized sizes and energies of hydrogen deuterium atoms.
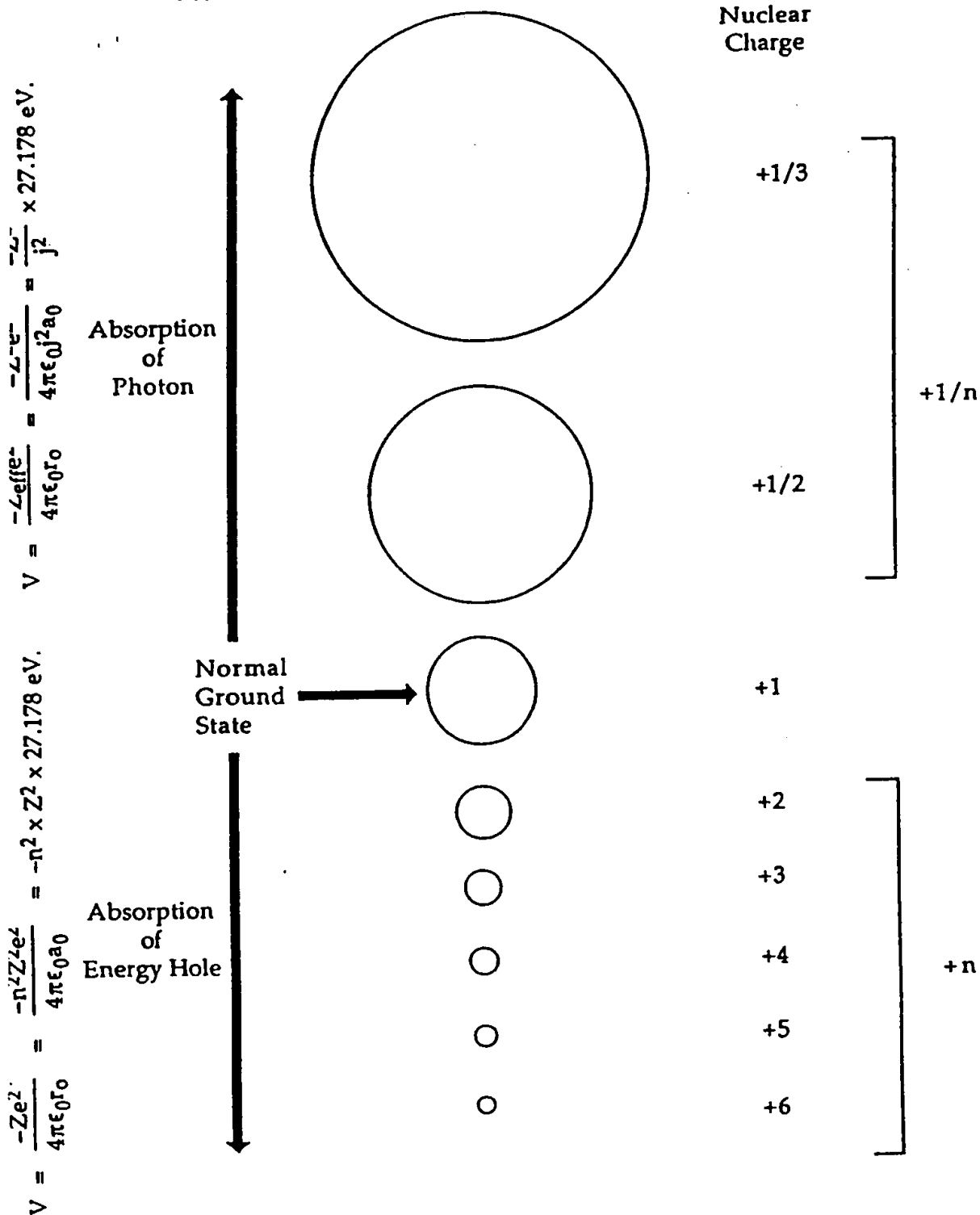
Effective
Nuclear
Charge

+1/3

+1/2

+1/n

Normal
Ground
State → +1

Absorption
of
Photon

+2

+3

+4

+5

+6

+n

Absorption
of
Energy Hole

$$V = \frac{-Z_{eff}e^2}{4\pi\epsilon_0 r_0} = \frac{-Z_{eff}e^2}{4\pi\epsilon_0 j^2 a_0} = \frac{-Z_{eff}^2}{j^2} \times 27.178 \text{ eV.}$$

$$V = \frac{-Ze^2}{4\pi\epsilon_0 r_0} = \frac{-n^2 Z^2 e^2}{4\pi\epsilon_0 a_0} = -n^2 \times Z^2 \times 27.178 \text{ eV.}$$

The electri
r_n, where
1.6).   Thus
smaller el
deuterium
separation
for exampl
muon to el
orders of n
27.21 eV,
separation
internuclea
process is
   It is
protons, 'H
about 50%
the nuclei
Coulombic
possible.
   Hydr
ground sta
proton. In
photons

5.0kV 1.5kX 10.0μm
Ni wire

5.0kV 3.0kX 10.0μm
Ni wire
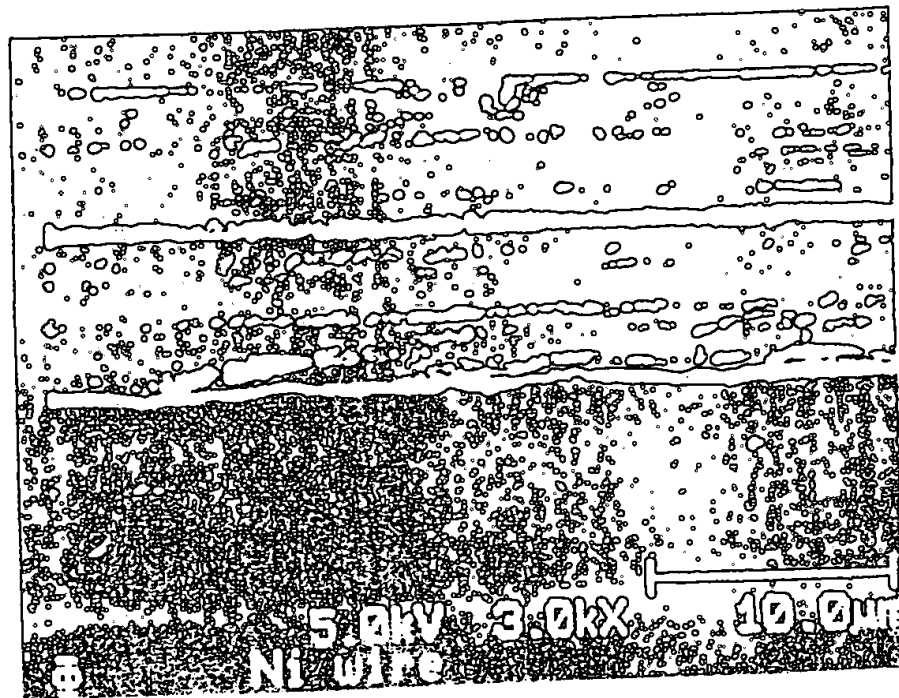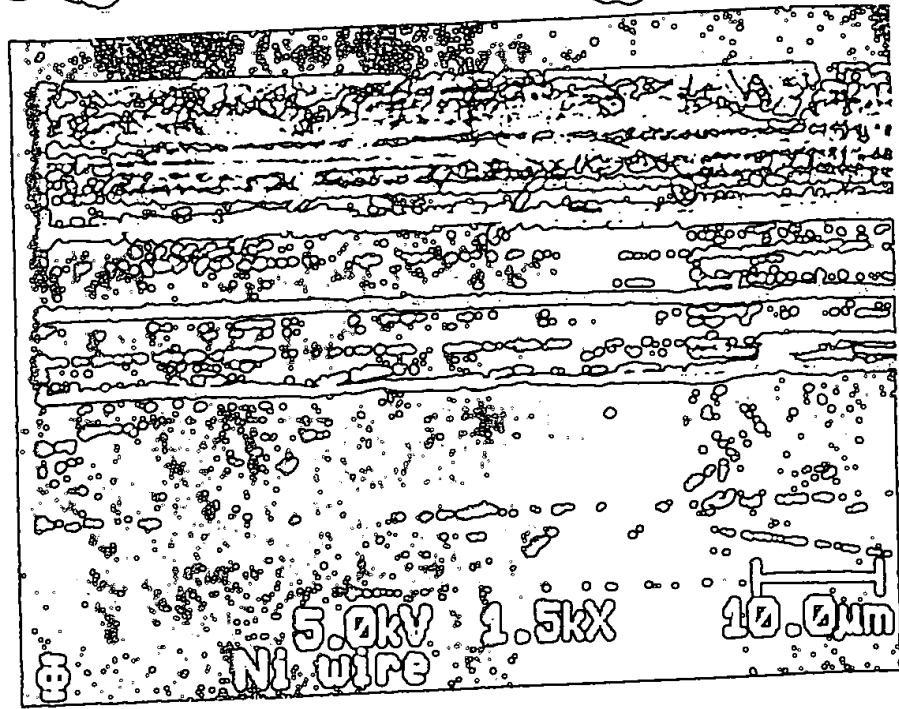
AES SURVEY V/F 11/29/93 AREA 1 ACQ TIME=13.34 MIN.

FILE: Nitest104 Ni wire treated for 24 Hr at the IRC.

SCALE FACTOR= 47.398 k c/s, OFFSET= 118.853 k c/s

BV=5.00KV BI=0.2793uA

5.0kV 1.5kX 10.0µm
Ni wire

5.0kV 350.0 X 100.0µm
Ni wire

5.0kV   150.0 X 100.0μm
Ni wire
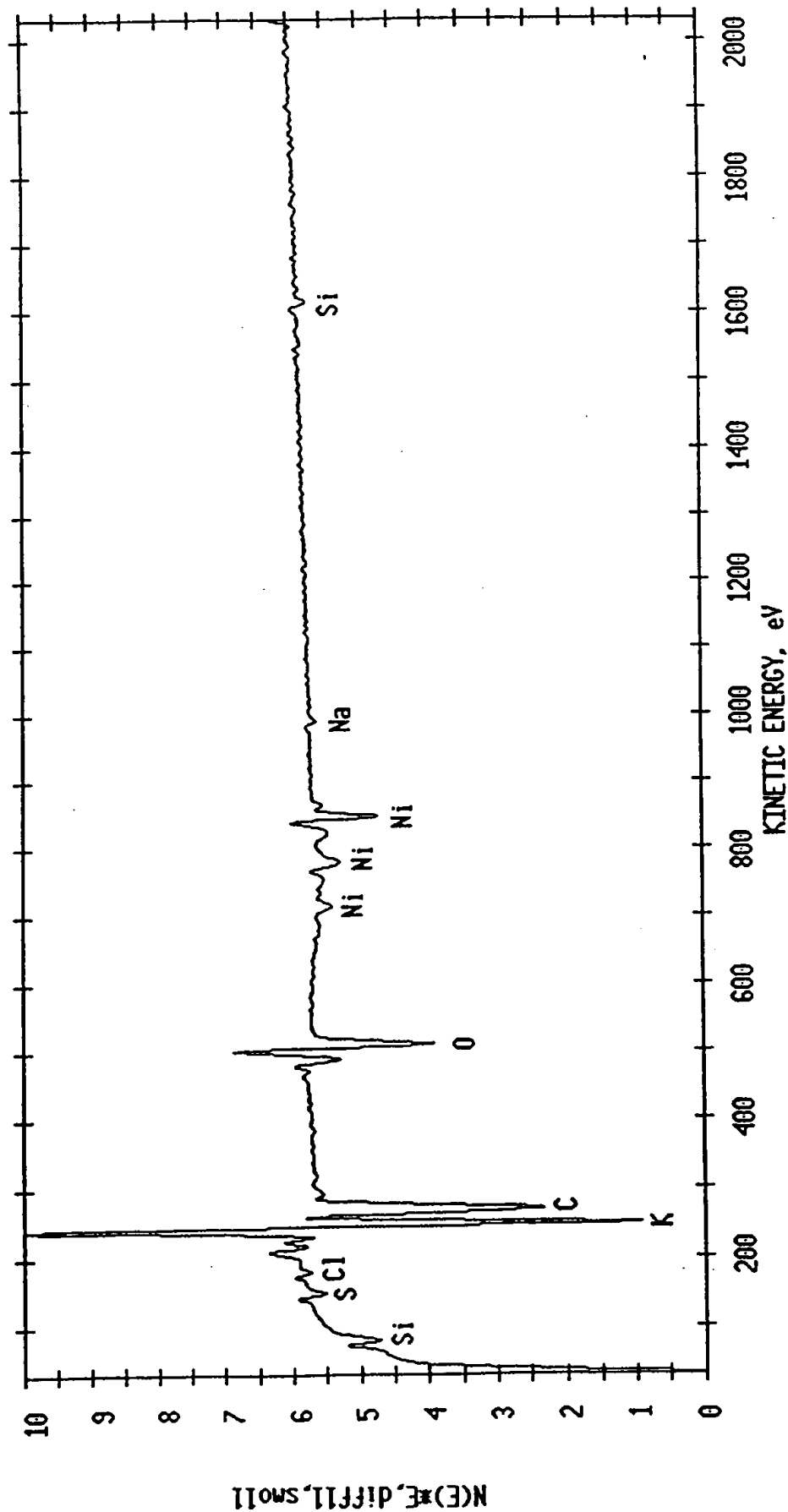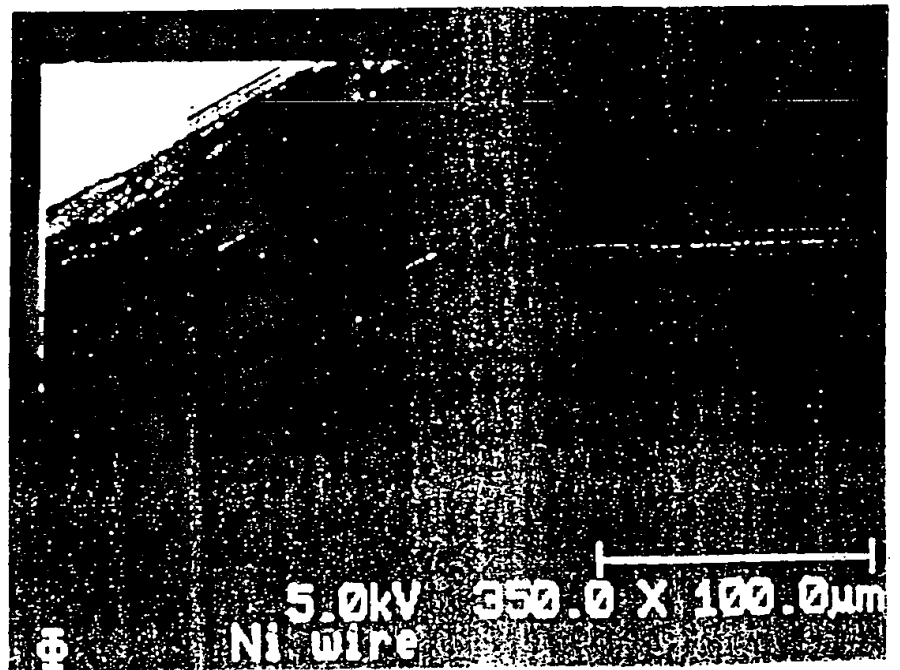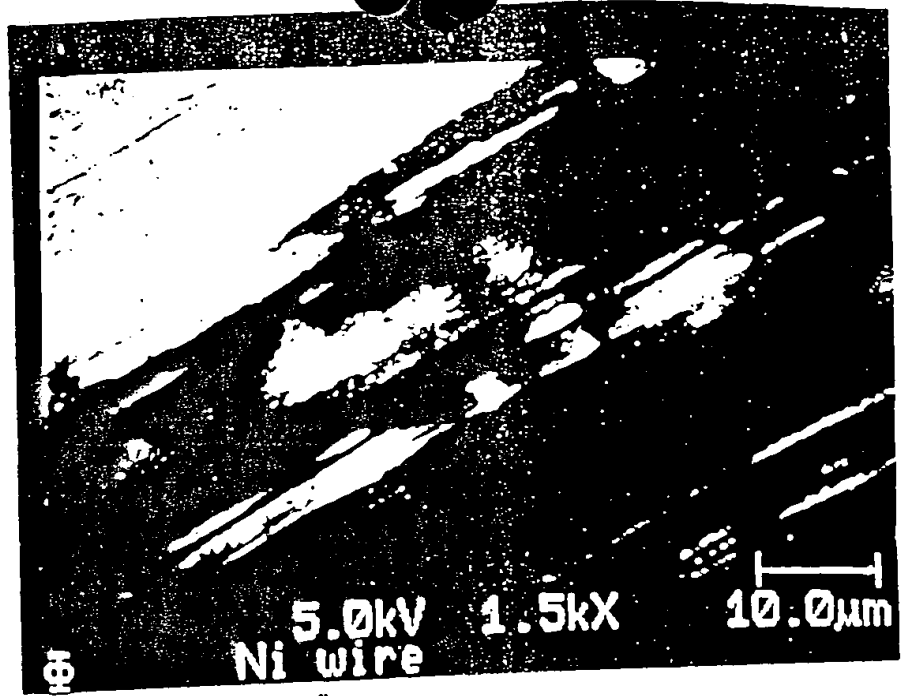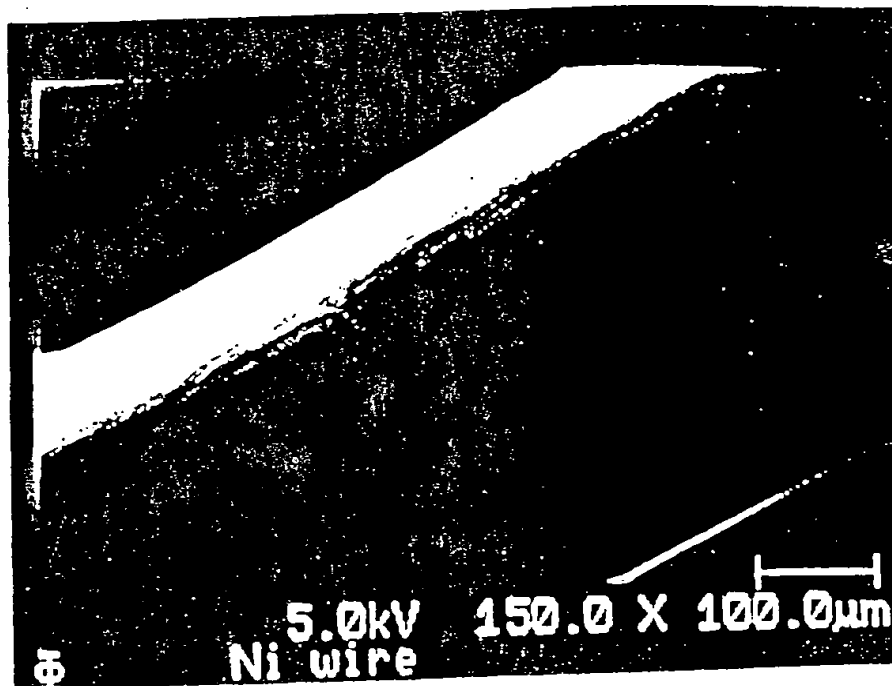
AES SURVEY V/F 11/29/93 AREA 1 ACQ TIME=6.67 MIN.

FILE: Nitest103 Ni wire treated for 24 Hr at the IRC.

BV=5.00kV BI=0.2793uA

SCALE FACTOR= 35.917 k c/s, OFFSET= 331.575 k c/s
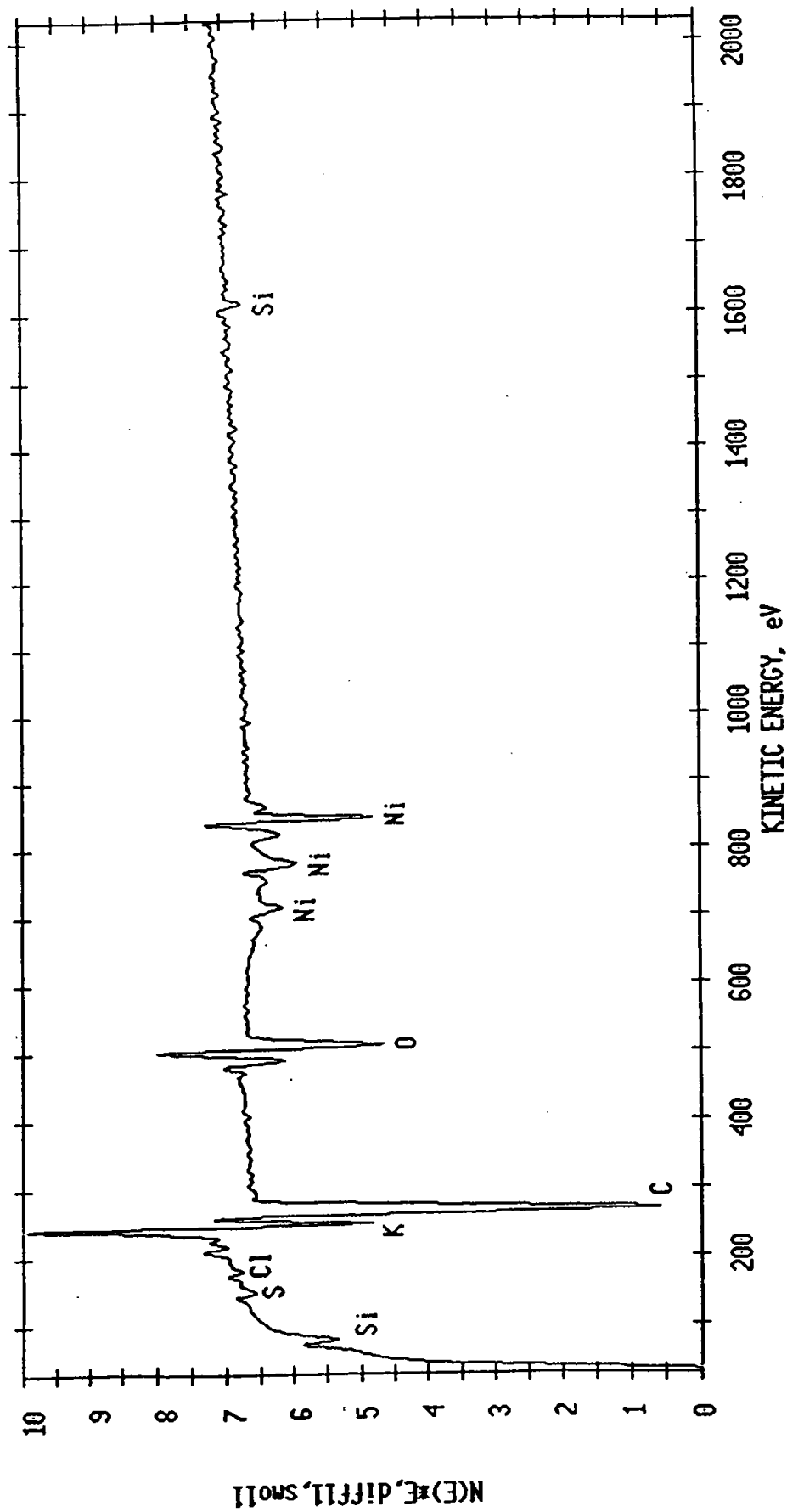
30-Nov-1993 09:39:41   Ni-AR-1   *Zoster*

Accelerating voltage   20.0 KeV

Beam - sample incidence angle   90.0 degrees

Xray emergence angle   35.0 degrees

Xray - window incidence angle   0.0 degrees

STANDARDLESS EDS ANALYSIS
(ZAF CORRECTIONS VIA MAGIC V)

ELEMENT & LINE	WEIGHT PERCENT	ATOMIC PERCENT*	PRECISION 2 SIGMA	K-RATIO**
Al KA	1.89	4.00	0.09	0.0059
Si KA	0.69	1.41	0.07	0.0029
Mn KA	0.08	0.08	0.02	0.0009
Fe KA	0.10	0.10	0.02	0.0013
Ni KA	97.24	94.41	0.42	0.9699

TOTAL   100.00

ITERATIONS   6

*NOTE: ATOMIC PERCENT is normalized to 100

**NOTE: K-RATIO = K-RATIO x R
        where R = reference(standard)/reference(sample)

NORMALIZATION FACTOR: 1.000

30-Nov-1993 09:41:17   Ni-AR-2   Spot

Accelerating voltage   20.0 KeV

Beam - sample incidence angle   90.0 degrees

Xray emergence angle   35.0 degrees

Xray - window incidence angle   0.0 degrees

STANDARDLESS EDS ANALYSIS
(ZAF CORRECTIONS VIA MAGIC V)

ELEMENT & LINE	WEIGHT PERCENT	ATOMIC PERCENT*	PRECISION 2 SIGMA	K-RATIO**
Al KA	2.22	4.66	0.10	0.0070
Si KA	0.80	1.62	0.07	0.0034
Mn KA	0.05	0.05	0.02	0.0006
Fe KA	0.05	0.05	0.02	0.0007
Ni KA	96.88	93.61	0.45	0.9660
TOTAL	100.00			

ITERATIONS   6

*NOTE: ATOMIC PERCENT is normalized to 100

**NOTE: K-RATIO = K-RATIO × R
       where R = reference(standard)/reference(sample)

NORMALIZATION FACTOR: 1.000

Accelerating voltage   20.0 KeV

Beam - sample incidence angle   90.0 degrees

Xray emergence angle   35.0 degrees

Xray - window incidence angle   0.0 degrees

STANDARDLESS EDS ANALYSIS
(ZAF CORRECTIONS VIA MAGIC V)

ELEMENT & LINE	WEIGHT PERCENT	ATOMIC PERCENT*	PRECISION 2 SIGMA	K-RATIO**
Al KA	4.11	8.52	0.10	0.0130
Mn KA	0.09	0.09	0.02	0.0011
Fe KA	0.07	0.07	0.02	0.0010
Ni KA	95.73	91.31	0.39	0.9535
TOTAL	100.00			

ITERATIONS   7

*NOTE: ATOMIC PERCENT is normalized to 100

**NOTE: K-RATIO = K-RATIO x R
       where R = reference(standard)/reference(sample)

NORMALIZATION FACTOR: 1.000

30-Nov-1993 09:42;46   Ni-AR-3   Sp.+

Accelerating voltage   20.0 KeV

Beam - sample incidence angle   90.0 degrees

Xray emergence angle   35.0 degrees

Xray - window incidence angle   0.0 degrees

STANDARDLESS EDS ANALYSIS
(ZAF CORRECTIONS VIA MAGIC V)

ELEMENT & LINE	WEIGHT PERCENT	ATOMIC PERCENT*	PRECISION 2 SIGMA	K-RATIO**
Al KA	3.17	6.61	0.12	0.0100
Si KA	0.71	1.42	0.06	0.0030
Mn KA	0.05	0.05	0.01	0.0005
Fe KA	0.08	0.08	0.02	0.0010
Ni KA	95.99	91.85	0.44	0.9561
TOTAL	100.00			

ITERATIONS   7

*NOTE: ATOMIC PERCENT is normalized to 100

**NOTE: K-RATIO = K-RATIO x R
        where R = reference(standard)/reference(sample)

NORMALIZATION FACTOR: 1.000

Accelerating voltage   20.0 KeV

Beam - sample incidence angle   90.0 degrees

Xray emergence angle   35.0 degrees

Xray - window incidence angle   0.0 degrees

STANDARDLESS EDS ANALYSIS
(ZAF CORRECTIONS VIA MAGIC V)

ELEMENT & LINE	WEIGHT PERCENT	ATOMIC PERCENT*	PRECISION 2 SIGMA	K-RATIO**
Al KA	3.80	7.90	0.12	0.0120
K KA	0.34	0.49	0.04	0.0029
Mn KA	0.04	0.04	0.01	0.0005
Fe KA	0.06	0.06	0.02	0.0008
Ni KA	95.75	91.50	0.43	0.9537

TOTAL   99.99

ITERATIONS   6

*NOTE: ATOMIC PERCENT is normalized to 100

**NOTE: K-RATIO = K-RATIO × R
       where R = reference(standard)/reference(sample)

NORMALIZATION FACTOR: 1.000

30-Nov-1993 09:54:39   Ni-T-1   *Roster*

Accelerating voltage   20.0 KeV

Beam — sample incidence angle   90.0 degrees

Xray emergence angle   35.0 degrees

Xray — window incidence angle   0.0 degrees

STANDARDLESS EDS ANALYSIS
(ZAF CORRECTIONS VIA MAGIC V)

ELEMENT & LINE	WEIGHT PERCENT	ATOMIC PERCENT*	PRECISION 2 SIGMA	K-RATIO**
Al KA	6.47	13.07	0.16	0.0208
K KA	0.35	0.48	0.04	0.0030
Mn KA	0.08	0.08	0.02	0.0009
Fe KA	0.06	0.06	0.02	0.0008
Ni KA	93.04	86.32	0.39	0.9247

Only ~1½-2 % probably

TOTAL   100.00

ITERATIONS   7

*NOTE: ATOMIC PERCENT is normalized to 100

**NOTE: K-RATIO = K-RATIO x R
        where R = reference(standard)/reference(sample)

NORMALIZATION FACTOR: 1.000

30-Nov-1993 10:00:28   Ni-T-3   Spot

Accelerating voltage   20.0 KeV

Beam - sample incidence angle   90.0 degrees

Xray emergence angle   35.0 degrees

Xray - window incidence angle   0.0 degrees

STANDARDLESS EDS ANALYSIS
(ZAF CORRECTIONS VIA MAGIC V)

ELEMENT & LINE	WEIGHT PERCENT	ATOMIC PERCENT*	PRECISION 2 SIGMA	K-RATIO**
Al KA	6.00	12.18	0.17	0.0193
K KA	0.38	0.53	0.04	0.0032
Mn KA	0.08	0.08	0.02	0.0009
Fe KA	0.07	0.06	0.02	0.0009
Ni KA	93.47	87.14	0.41	0.9293

Only ~1½.2%
probably

TOTAL   100.00

ITERATIONS   7

*NOTE: ATOMIC PERCENT is normalized to 100

**NOTE: K-RATIO = K-RATIO × R
       where R = reference(standard)/reference(sample)

NORMALIZATION FACTOR: 1.000

30-Nov-1993 10:02:41   Ni-T-4   Rostov

Accelerating voltage	20.0 KeV
Beam - sample incidence angle	90.0 degrees
Xray emergence angle	35.0 degrees
Xray - window incidence angle	0.0 degrees

STANDARDLESS EDS ANALYSIS
(ZAF CORRECTIONS VIA MAGIC V)

ELEMENT & LINE	WEIGHT PERCENT	ATOMIC PERCENT*	PRECISION 2 SIGMA	K-RATIO**
Al KA	1.46	3.12	0.09	0.0045
K KA	0.25	0.36	0.03	0.0021
Mn KA	0.09	0.09	0.02	0.0010
Fe KA	0.09	0.09	0.02	0.0012
Ni KA	98.11	96.33	0.42	0.9795
TOTAL	100.00			

ITERATIONS   6

*NOTE: ATOMIC PERCENT is normalized to 100

**NOTE: K-RATIO = K-RATIO × R
       where R = reference(standard)/reference(sample)

NORMALIZATION FACTOR: 1.000

ESCA SURVEY 11/19/93 ANGLE= 15 deg ACQ TIME=29.36 min
FILE: Nitest28 Ni wire untreated (base line) using Al X-Ray's.
SCALE FACTOR= 10.010 k c/s, OFFSET= 1.574 k c/s PASS ENERGY=178.950 eV Al 400 W

ESCA MULTIPLEX   11/19/93   EL=C1   REG 1   ANGLE= 15 deg   ACQ TIME=4.19 min
FILE: Nitest27   Ni wire untreated (base line) using Al X-Ray's.
SCALE FACTOR= 0.928 k c/s,   OFFSET= 5.646 k c/s   PASS ENERGY=143.050 eV   Al   400 W

Shifted -1.1 eV.

N(E)/E, sat

BINDING ENERGY, eV
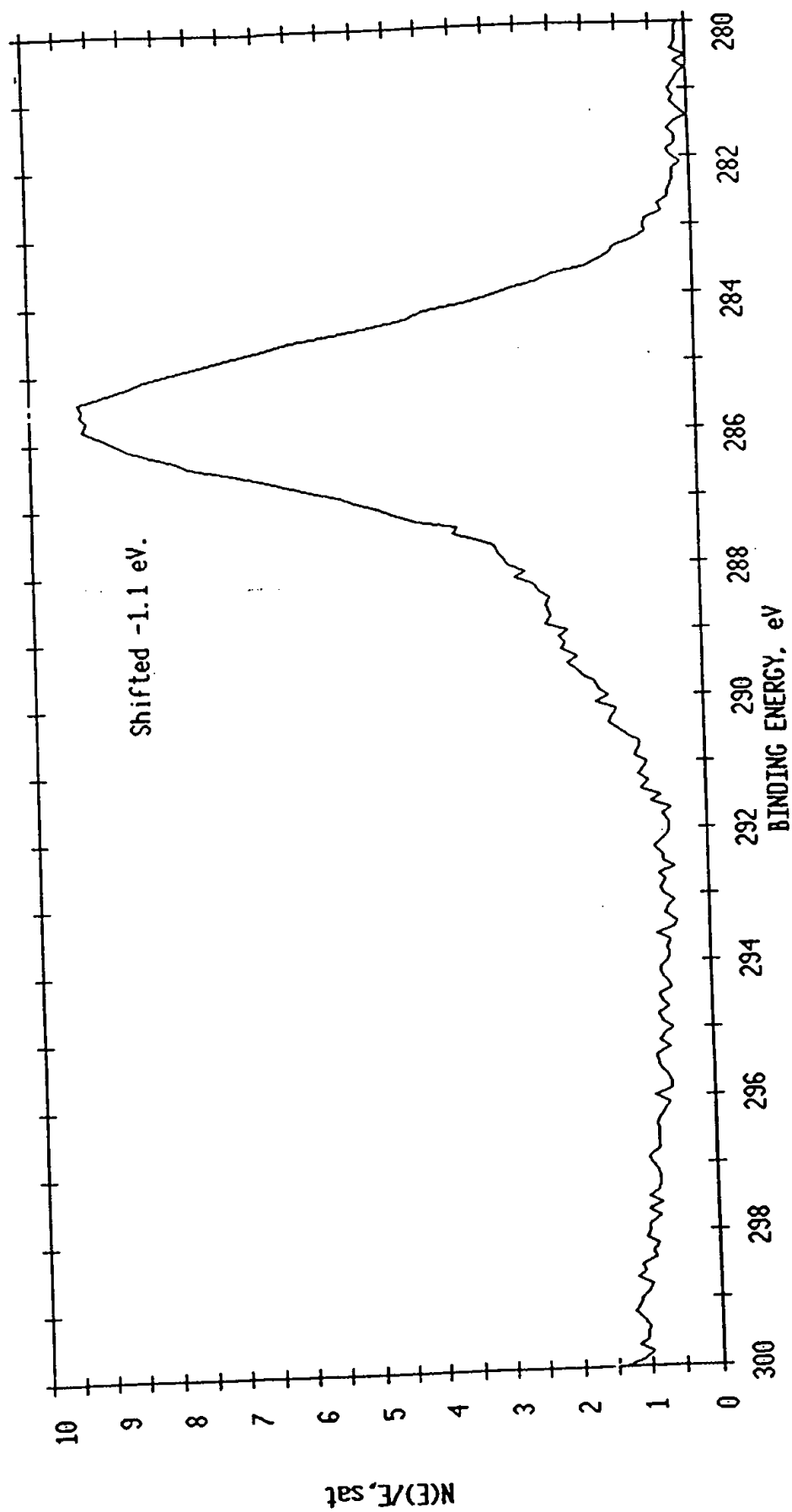
ESCA MULTIPLEX 11/29/93 EL=Fe1 REG 1 ANGLE= 15 deg ACO TIME=116.96 min
FILE: Nitest55 More Fe spectra of Ni wire treated overnight at the IRC
SCALE FACTOR= 0.134 k c/s, OFFSET= 9.937 k c/s PASS ENERGY=143.050 eV Mg 300 W

N(E)/E,sat,smoll

BINDING ENERGY, eV
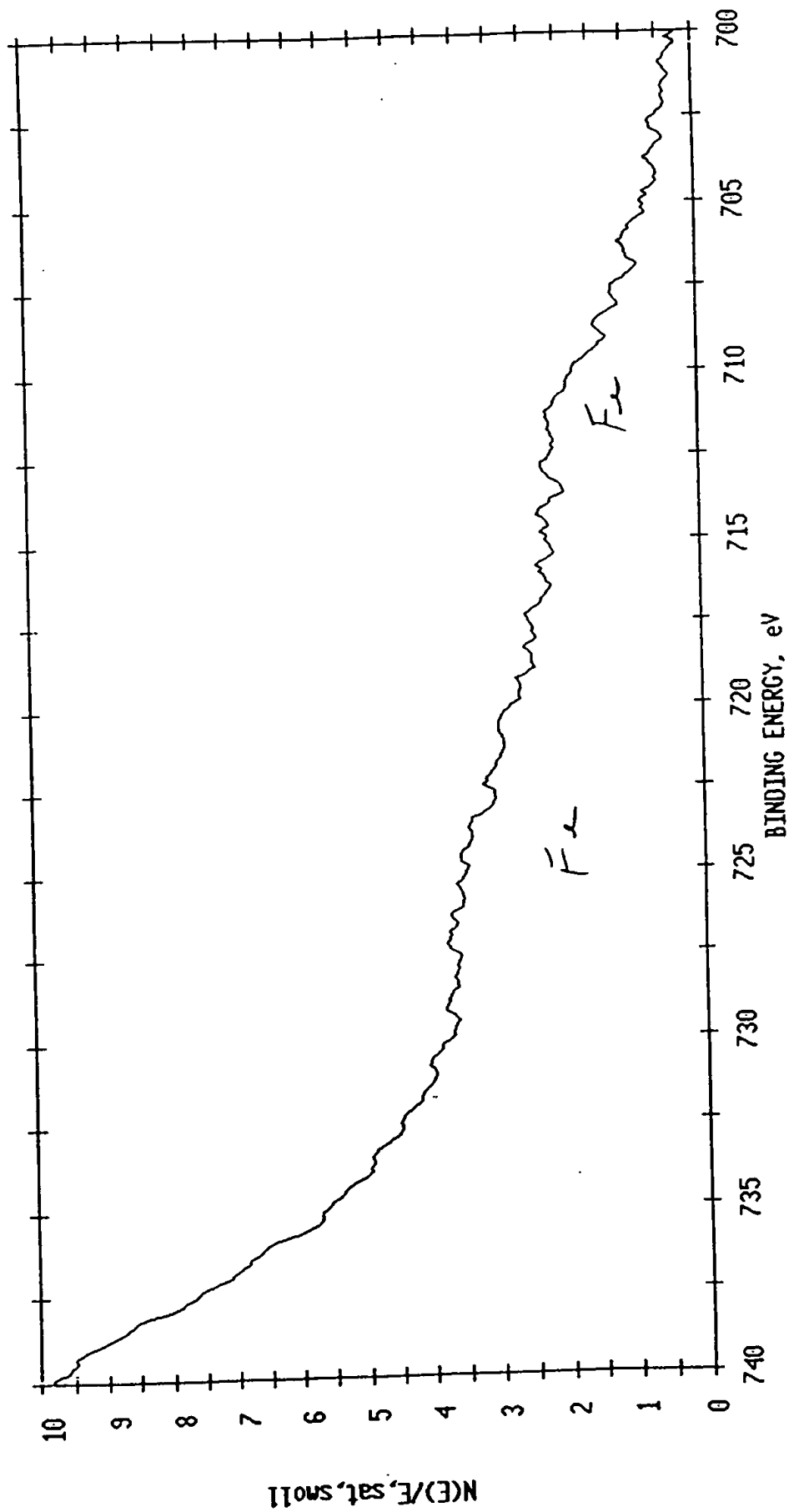
ESCA SURVEY 11/24/93 ANGLE= 15 deg ACQ TIME=29.36 min

FILE: Nitest51 Ni wire treated overnight at IRC.

SCALE FACTOR= 7.011 k c/s, OFFSET= 0.979 k c/s PASS ENERGY=178.950 eV Al 400 W

Figure axes: N(E)/E,sat (vertical, 0 to 10); BINDING ENERGY, eV (horizontal, 0 to 1000)

Peak labels: —O2s, —Fe3p, —Ni3p, —Si2p, —Si2s, —Cl2p, —K2p, —C1s, —Ca2p, —K2s, —N1s, —O1s, —Ni LMM, —F1s, —Fe2p3, —Fe2p1, —Fe LMM, —Ni2p3, —Ni2p1, —O KVV

Binding Energy [eV]

Counts x10³

Figure 4C

Figure 4.3
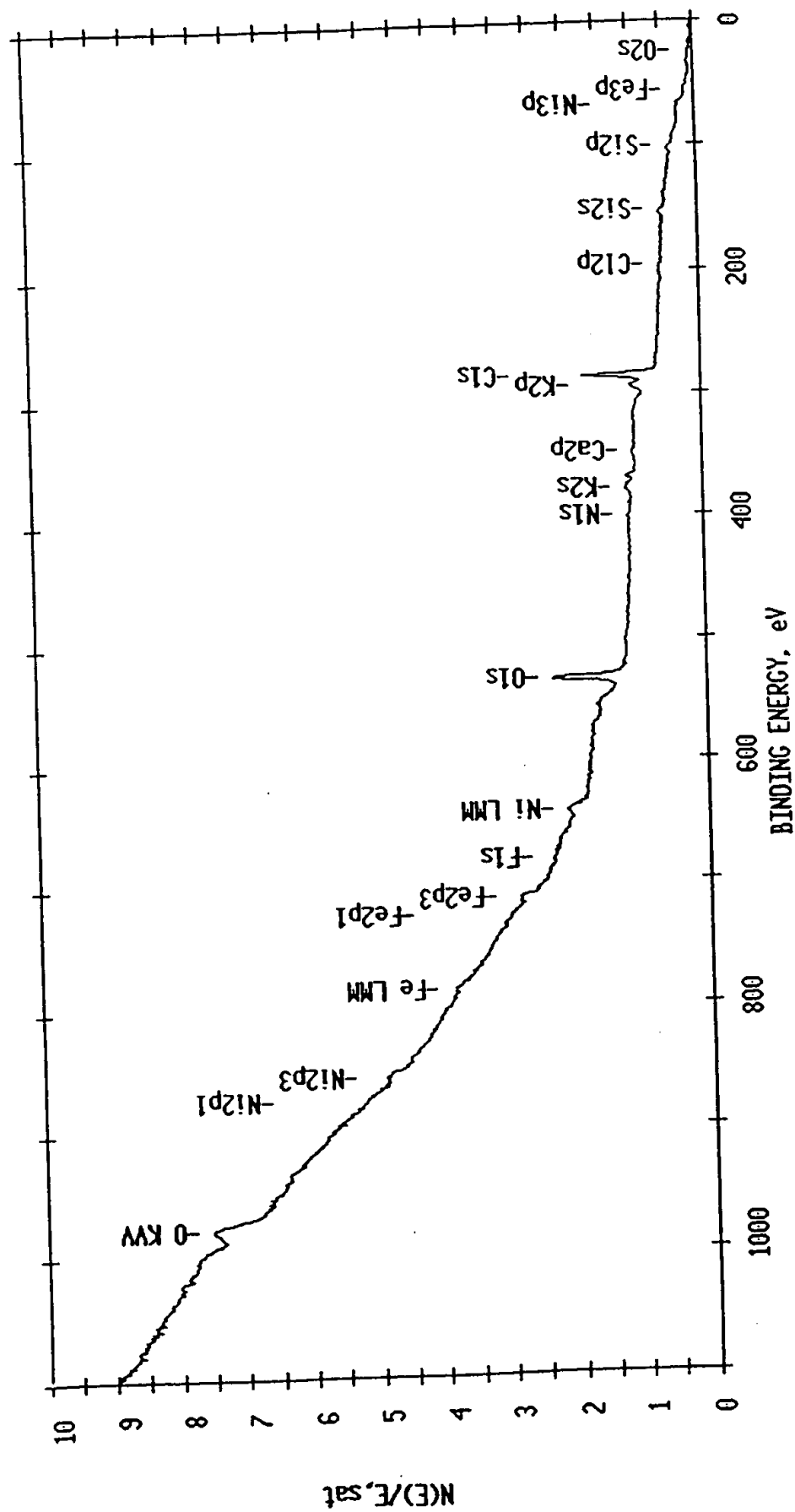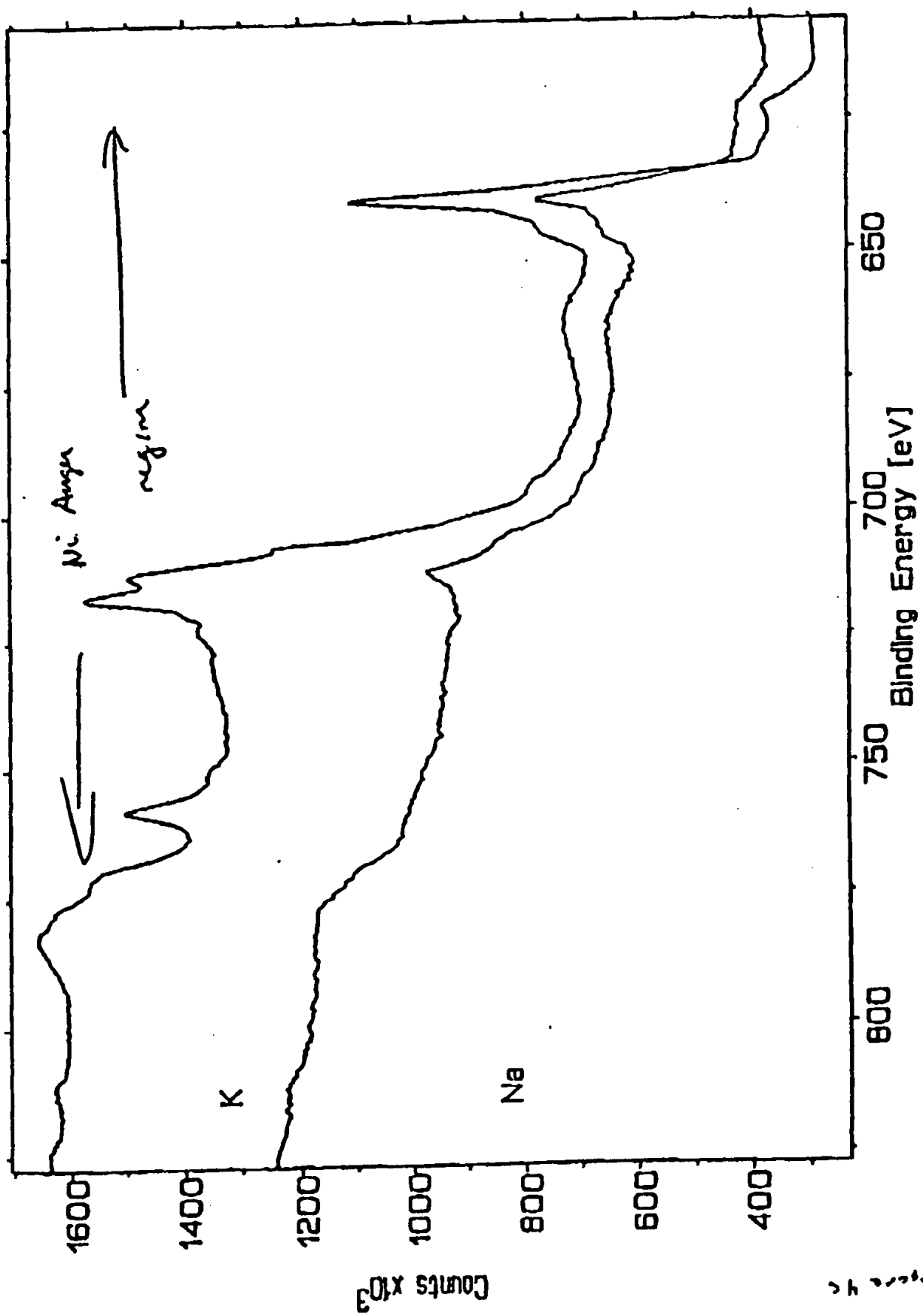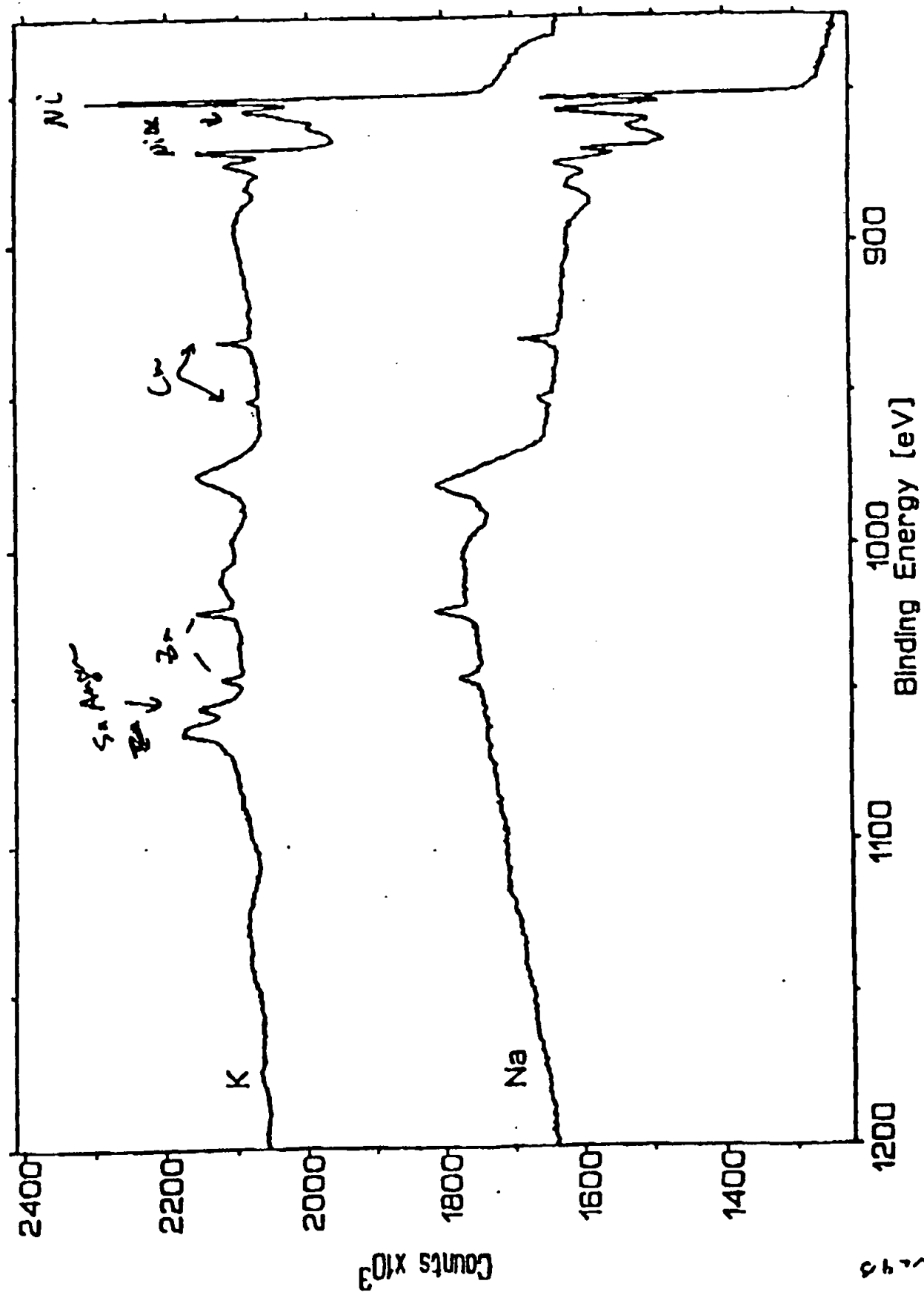
ESCA SURVEY 11/29/93   ANGLE= 15 deg   ACQ TIME=29.36 min

FILE: Nitest56   Ni wire treated over Thanksgiving weekend.

SCALE FACTOR= 4.822 k c/s,   OFFSET= 0.306 k c/s   PASS ENERGY=178.950 eV   Mg 300 W
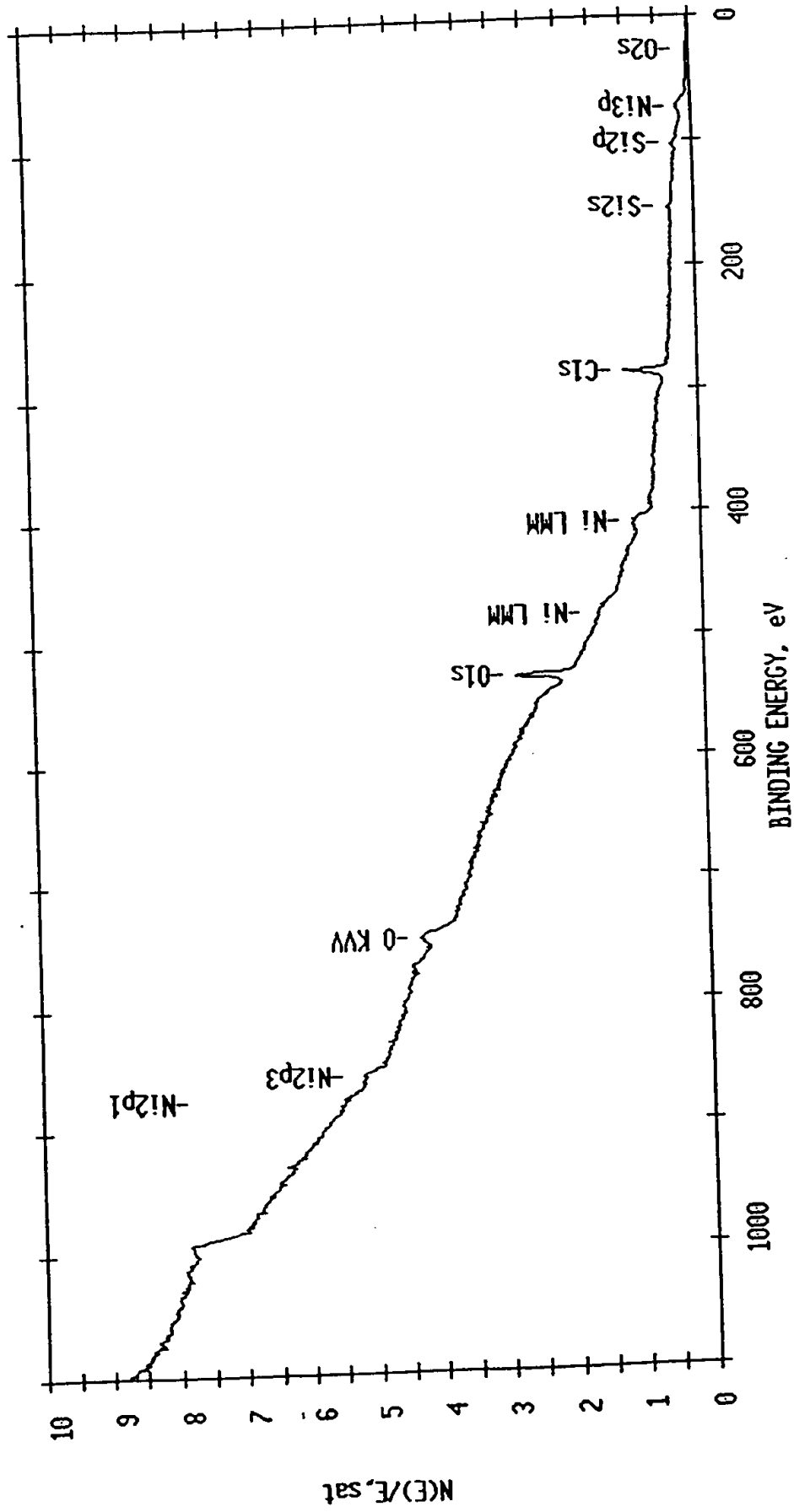
N(E)/E,sat

BINDING ENERGY, eV

ESCA MULTIPLEX   11/24/93   EL= REG 2   ANGLE= 15 deg   ACQ TIME=114.08 min

FILE: Nitest50   Ni wire treated overnight at IRC.

SCALE FACTOR= 0.095 k c/s,   OFFSET= 1.036 k c/s   PASS ENERGY=143.050 eV   Al   400 W
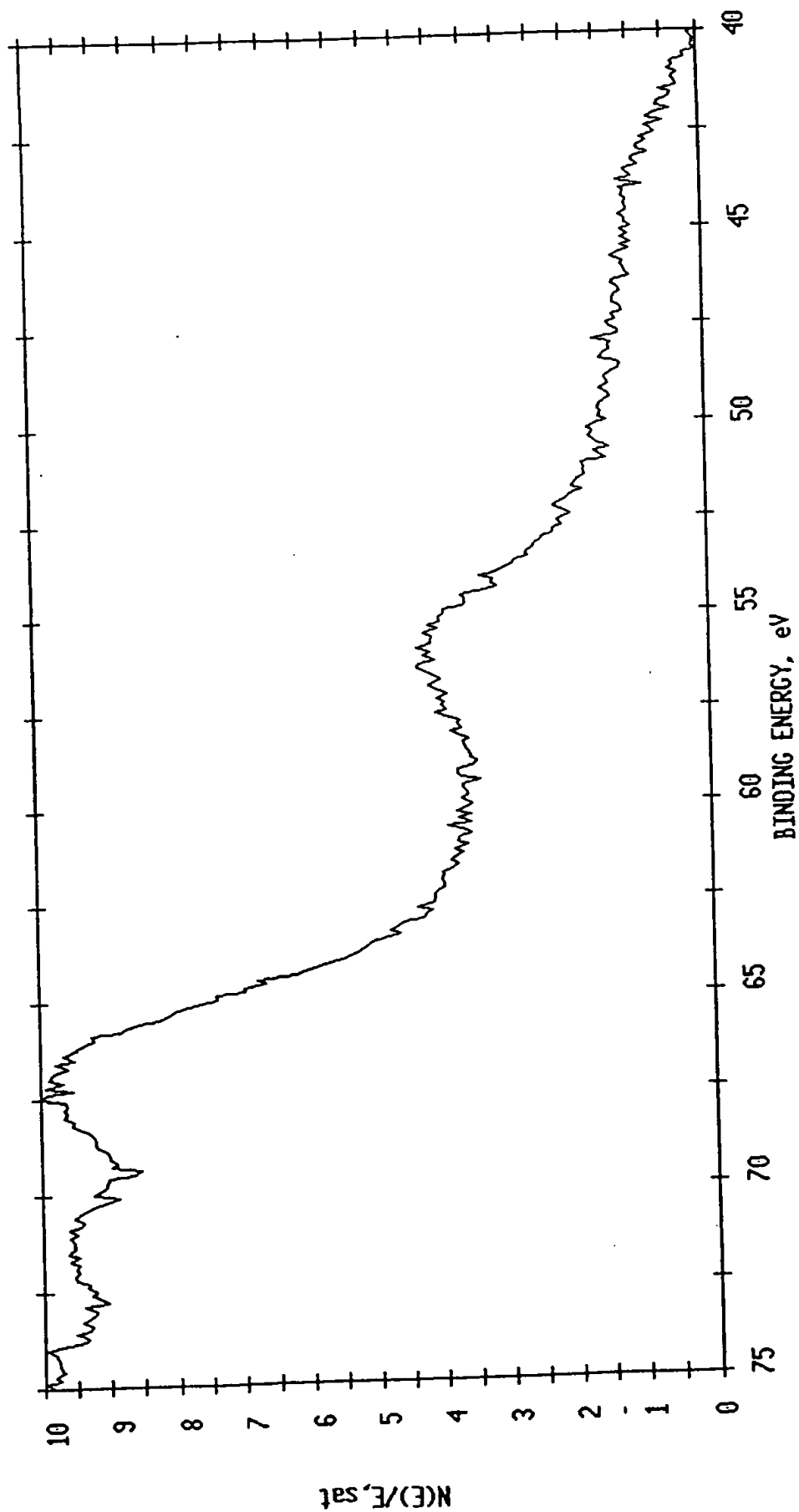
ESCA MULTIPLEX 11/24/93 EL=C1 REG 1 ANGLE= 15 deg ACQ TIME=7.54 min

FILE: Nitest50 Ni wire treated overnight at IRC.

SCALE FACTOR= 0.569 k c/s, OFFSET= 3.655 k c/s PASS ENERGY=143.050 eV Al 400 W
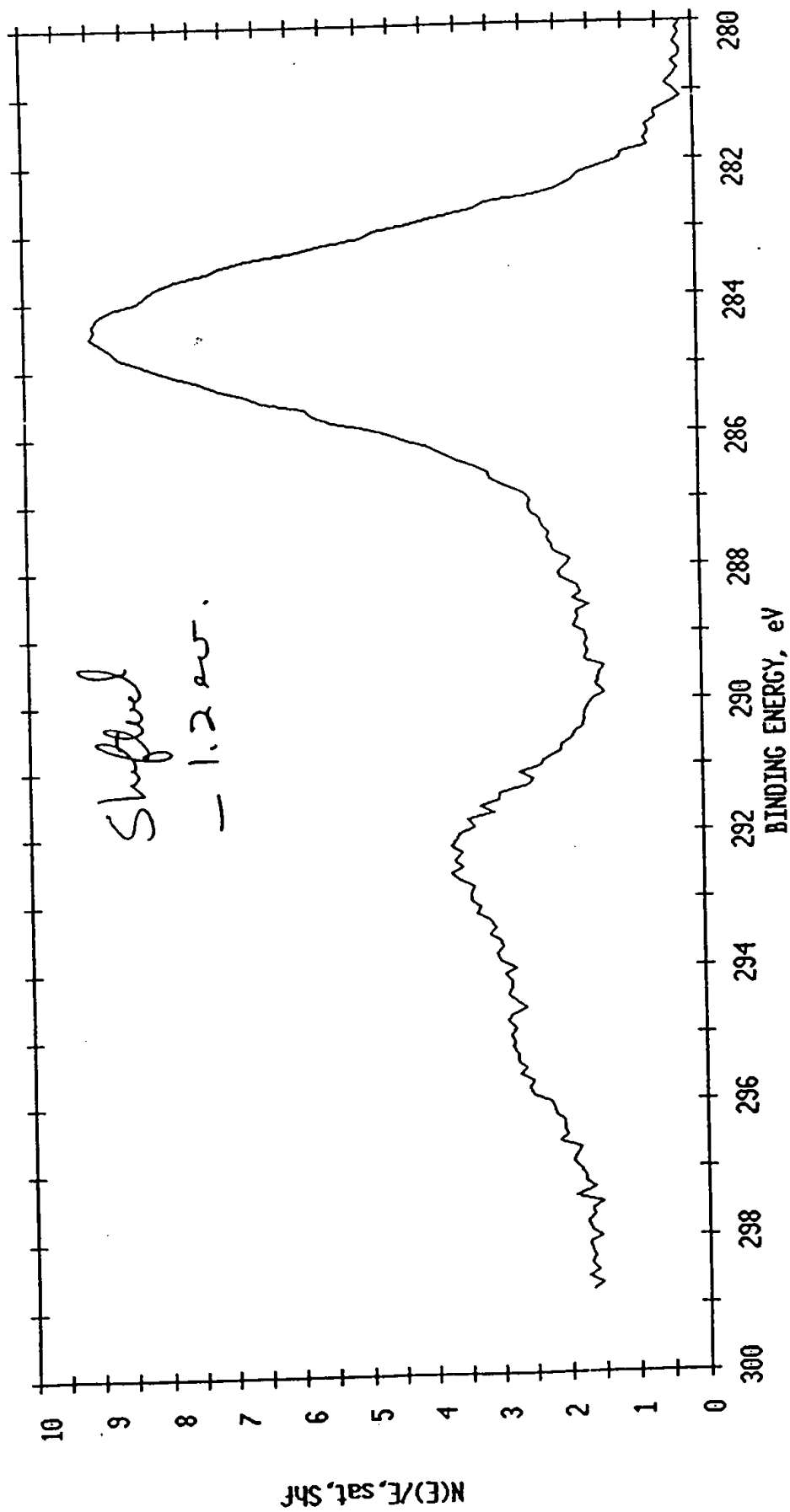
Shuffled
-1.2 ev.

BINDING ENERGY, eV

N(E)/E,sat.shf

ESCA MULTIPLEX 11/19/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=61.43 min

FILE: Nitest27 Ni wire untreated (base line) using Al X-Ray's.

SCALE FACTOR= 0.307 k c/s, OFFSET= 1.683 k c/s PASS ENERGY=143.050 eV Al 400 W

Treated and untreated Ni wire

BINDING ENERGY, eV

N(E)/E

INEL
Idaho National Engineering Laboratory
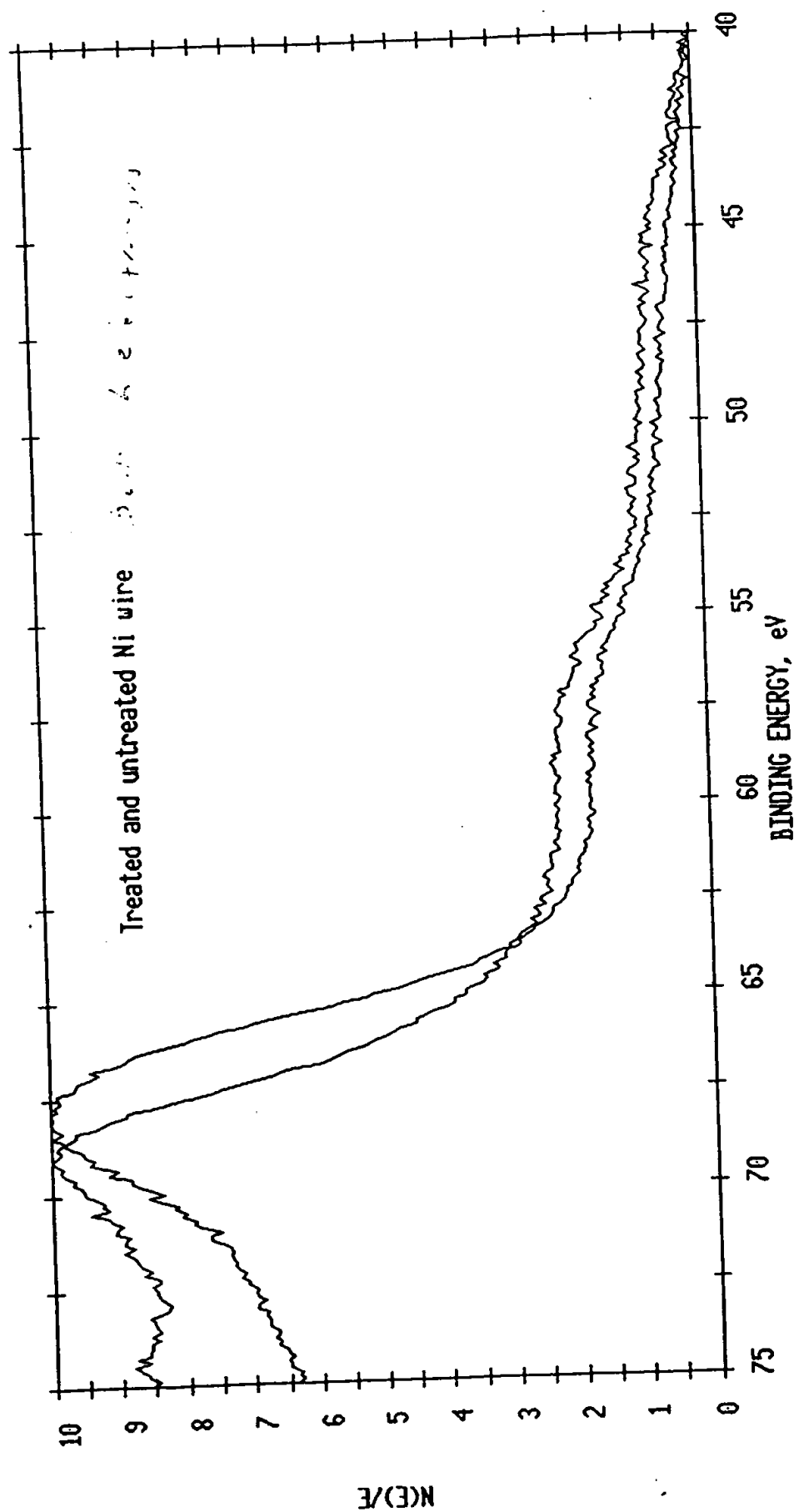
SPACE and ADVANCED PROGRAMS UNIT
P. O. BOX 1625
IDAHO FALLS ID 83415

To: _Mike Hawkins_

Company/Org: _____

Fax No: _____

Verify No: _____

From: _Mike Jacox_

Company/Org: _____

Phone No: _____

Fax No: 1-208-526-2061 (FTS) 8-208-526-2061

No. of pages including the cover page: _2_

Note:
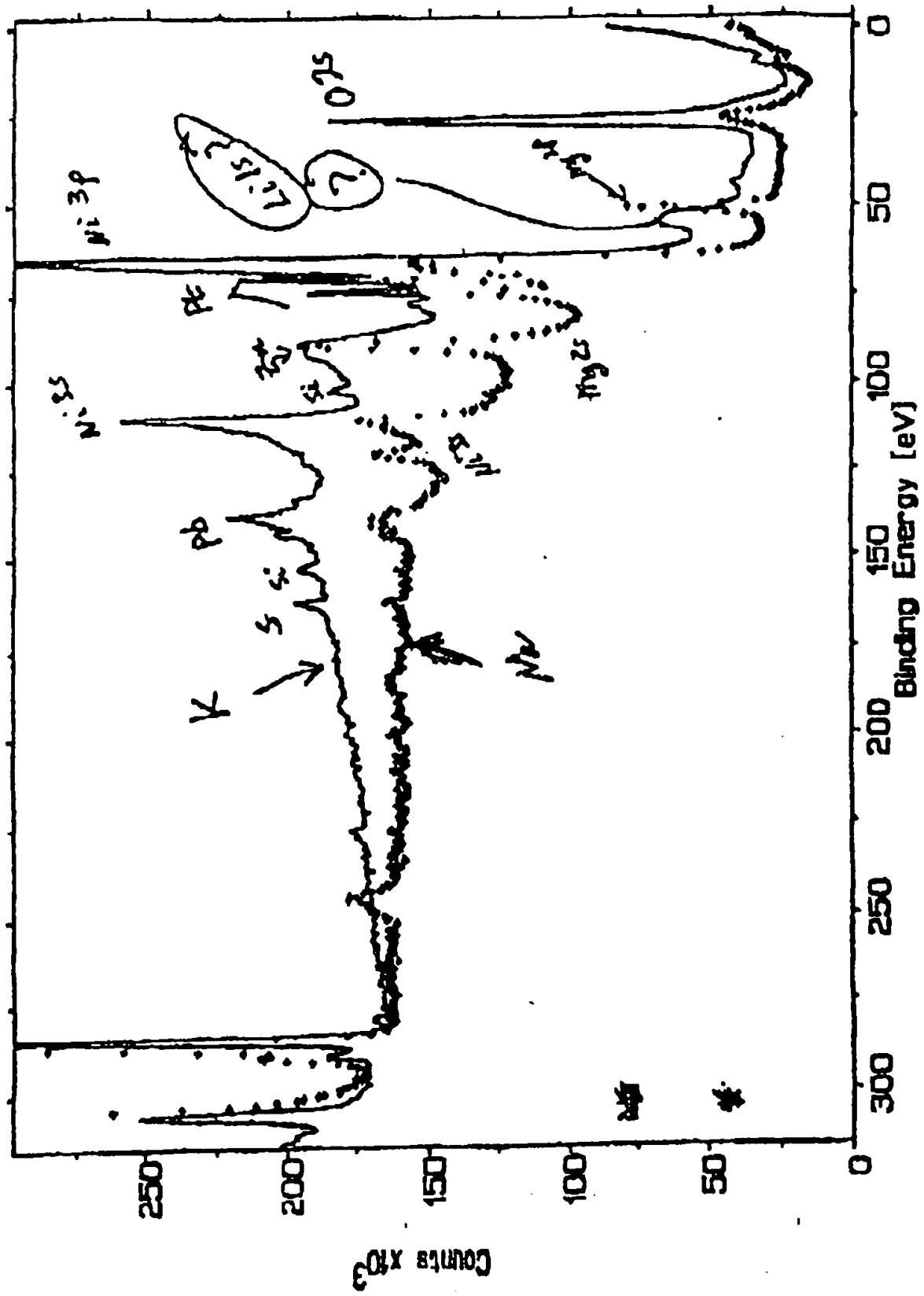
Figure 4 A

Binding Energy [eV]

Counts x10³

O 2s

Ni 3p

Pt

Ni 2s

Pb

S S

K

Nb

Binding Energy [eV]

ESCA MULTIPLEX 11/18/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=67.28 min
FILE: Nitest20 Ni wire processed in lab. as received.
SCALE FACTOR= 0.331 k c/s, OFFSET= 2.436 k c/s PASS ENERGY=143.050 eV Al 400 W

BINDING ENERGY, eV

N(E)/E,sat

ESCA MULTIPLEX 11/24/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=114.08 min

FILE: Nitest50 Ni wire treated overnight at IRC.

SCALE FACTOR= 0.116 k c/s, OFFSET= 1.036 k c/s PASS ENERGY=143.050 eV Al 400 W

BINDING ENERGY, eV

N(E)/E,sat.Shf

a ∎ Energy (eV) | ▮ 54.700 | ▮ Cursor | Counts | ▮ 28173 Counts/Sec | 1445

Counts

N(E)/E,sat,shf

BINDING ENERGY, eV

Figure 4.11
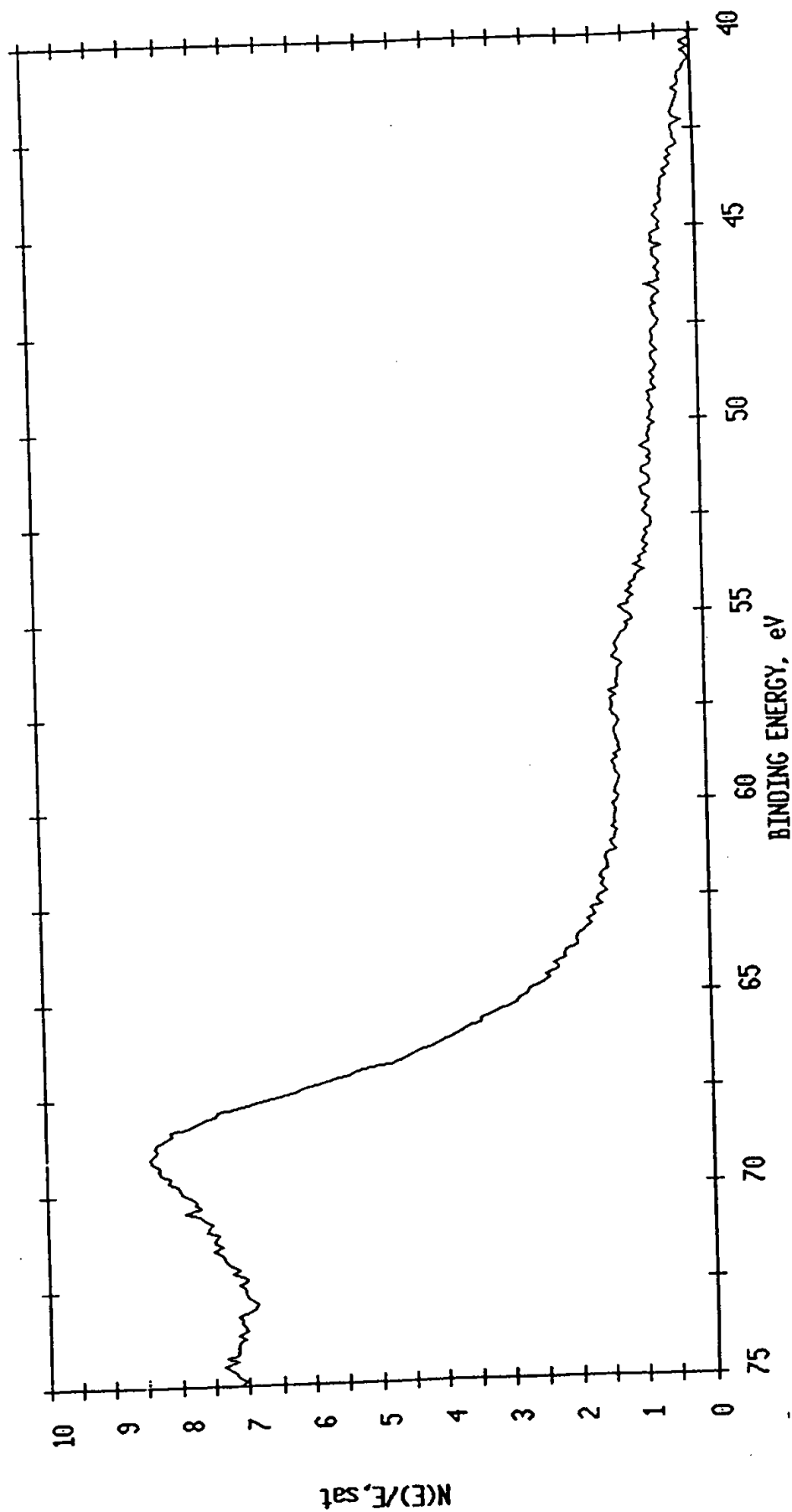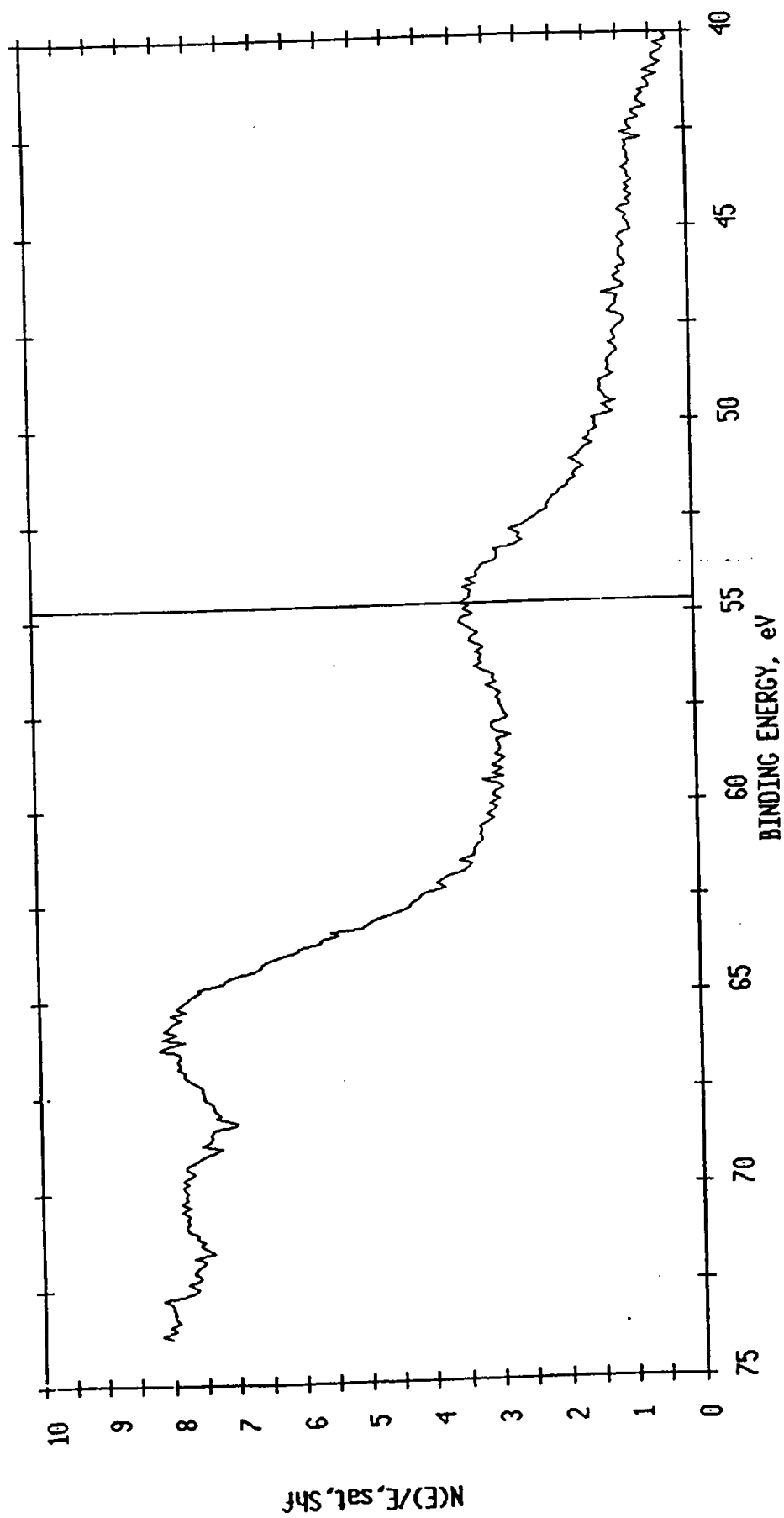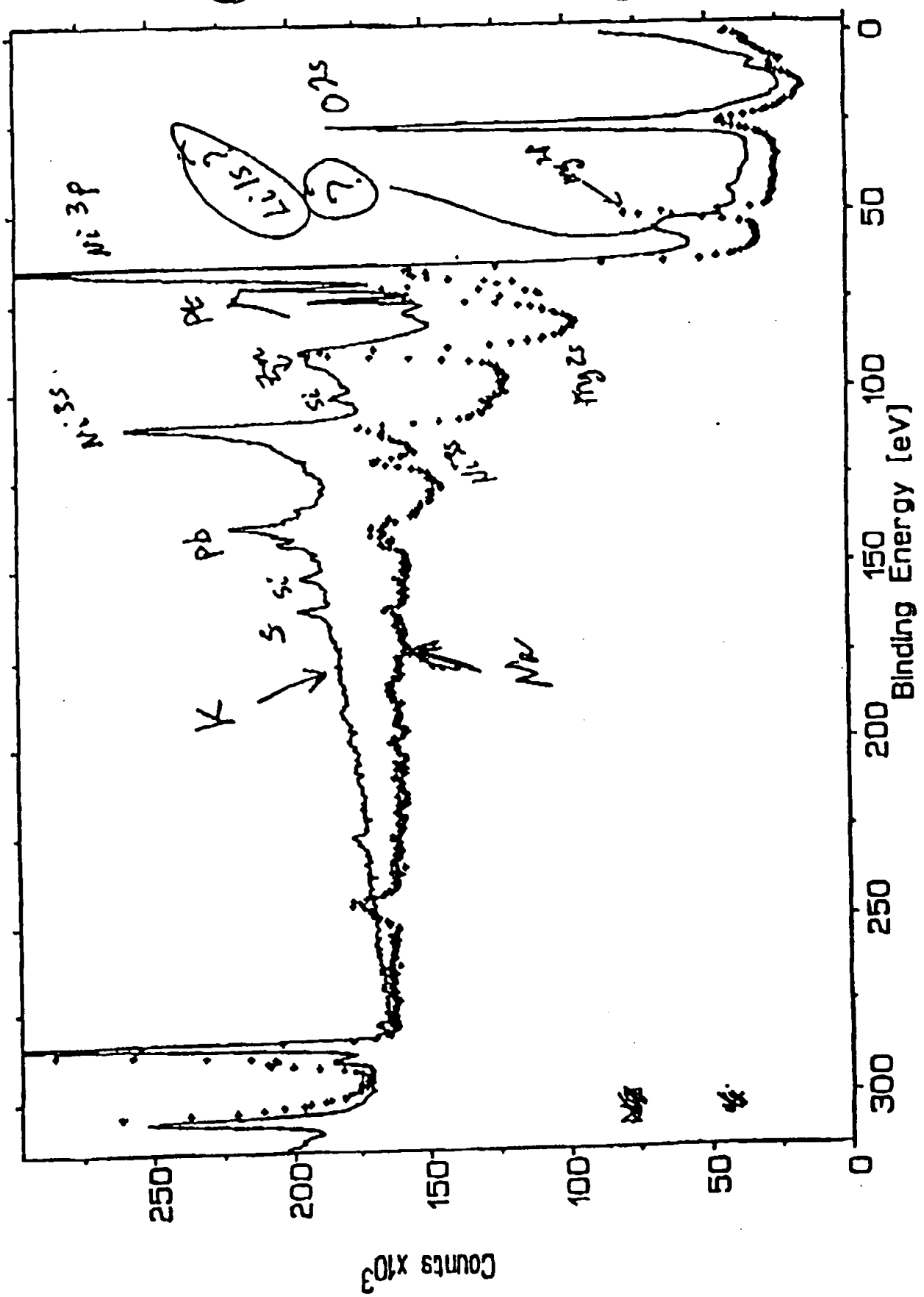
ESCA SURVEY 11/23/93 ANGLE= 15 deg ACQ TIME=29.36 min

FILE: Nitest40 Ni foil after treatment for 5 days.

SCALE FACTOR= 9.221 k c/s, OFFSET= 0.532 k c/s PASS ENERGY=178.950 eV Al 400 W

N(E)/E,sat

10
9
8
7
6
5
4
3
2
1
0

—O2s

—Si2p
—Si2s

—C1s —K2p

—K2s

—O1s

—F1s

—Ni2p

—O KVV

BINDING ENERGY, eV

0   200   400   600   800   1000
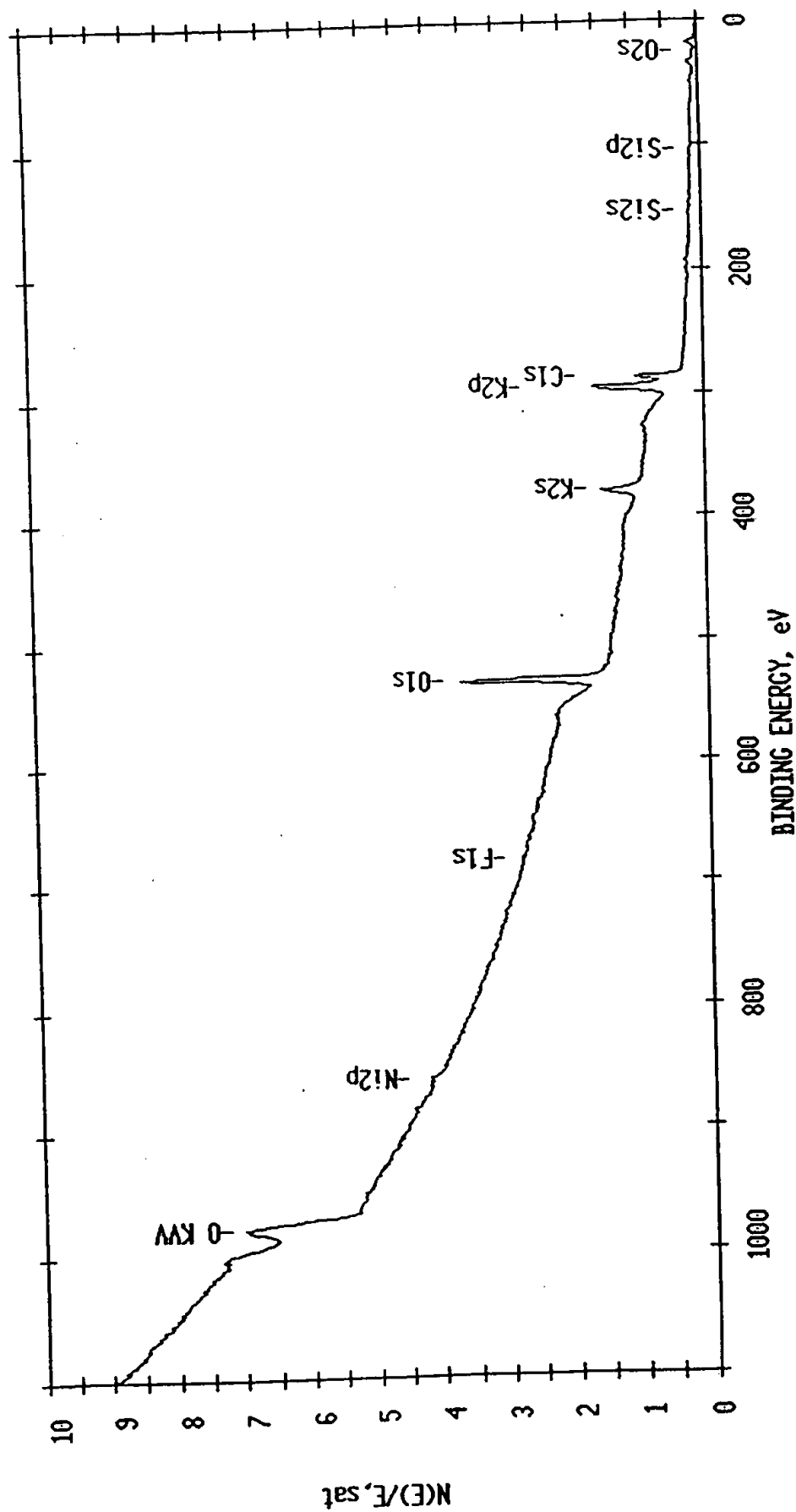
ESCA MULTIPLEX 11/23/93 EL=C1 REG 1 ANGLE= 15 deg ACQ TIME=2.51 min
FILE: Nitest41 Ni foil after treatment for 5 days.
SCALE FACTOR= 0.905 k c/s, OFFSET= 1.883 k c/s PASS ENERGY=143.050 eV Al 400 W
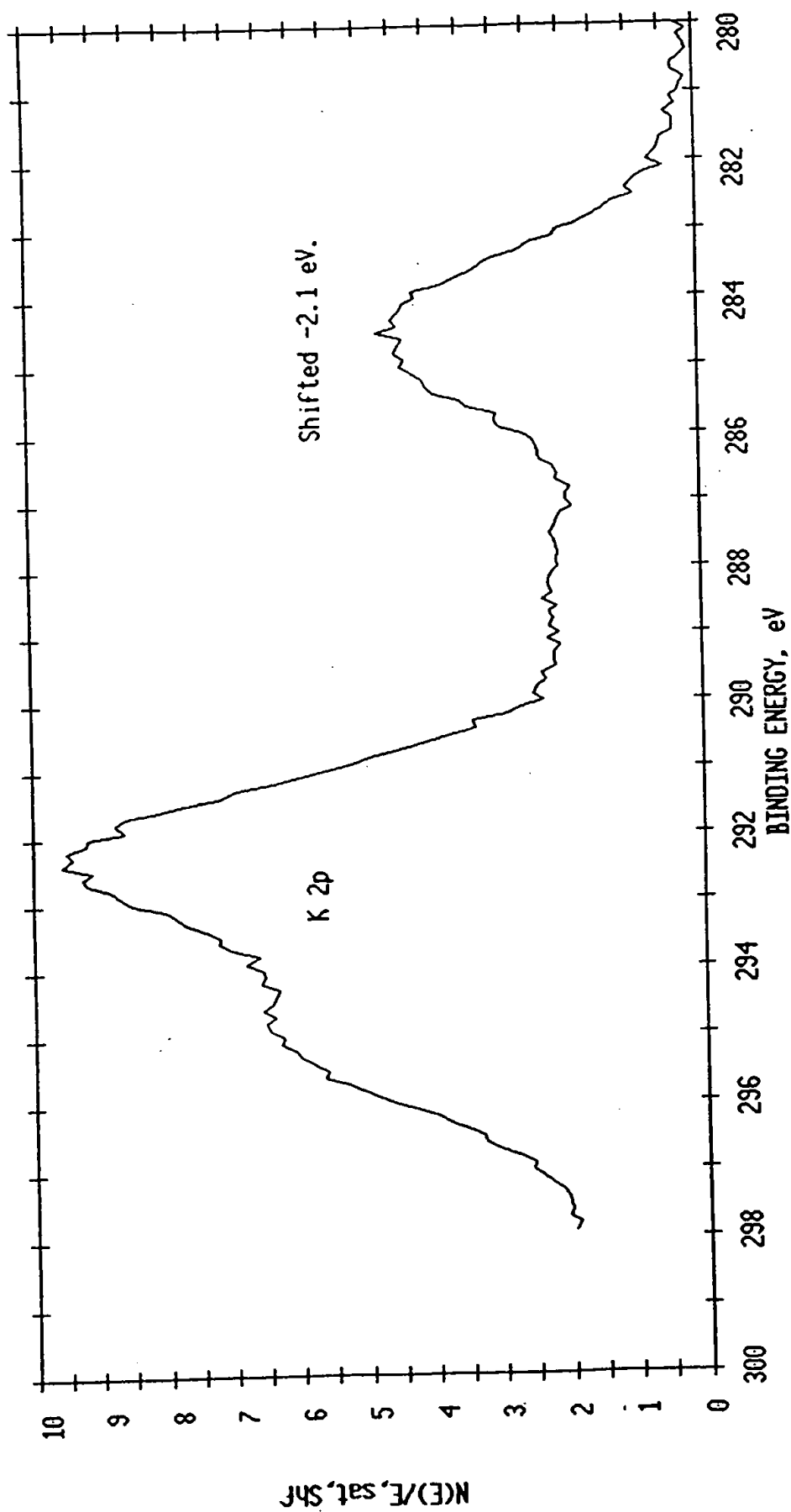
Shifted -2.1 eV.

K 2p

BINDING ENERGY, eV

N(E)/E,sat,Shf

ESCA MULTIPLEX 11/23/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=114.08 min
FILE: Nitest41 Ni foil after treatment for 5 days.
SCALE FACTOR= 0.029 k c/s, OFFSET= 0.855 k c/s PASS ENERGY=143.050 eV Al 400 W
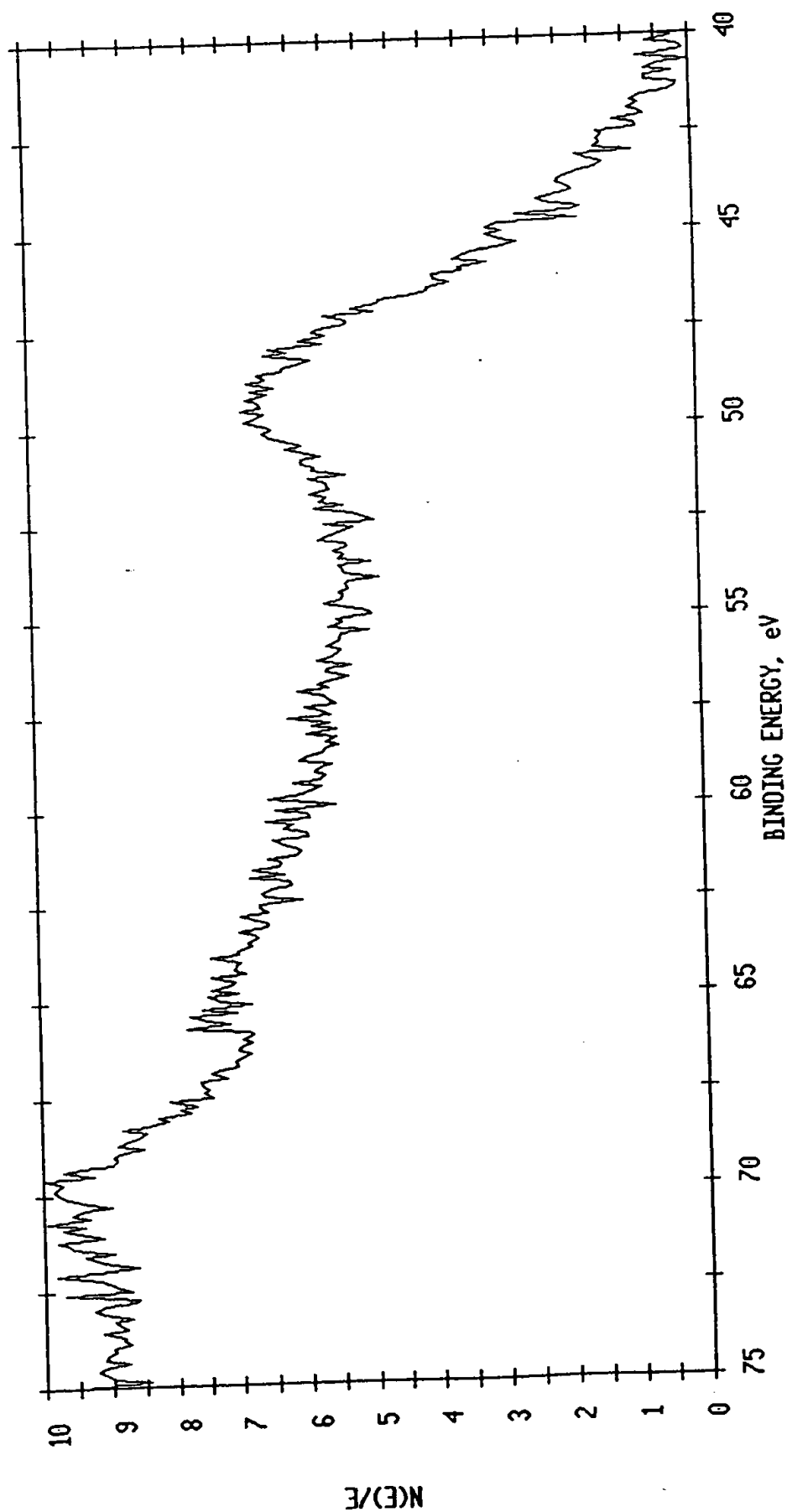
ESCA MULTIPLEX 11/23/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=114.08 min

FILE: Nitest41 Ni foil after treatment for 5 days.

SCALE FACTOR= 0.039 k c/s, OFFSET= 0.755 k c/s PASS ENERGY=143.050 eV Al 400 W
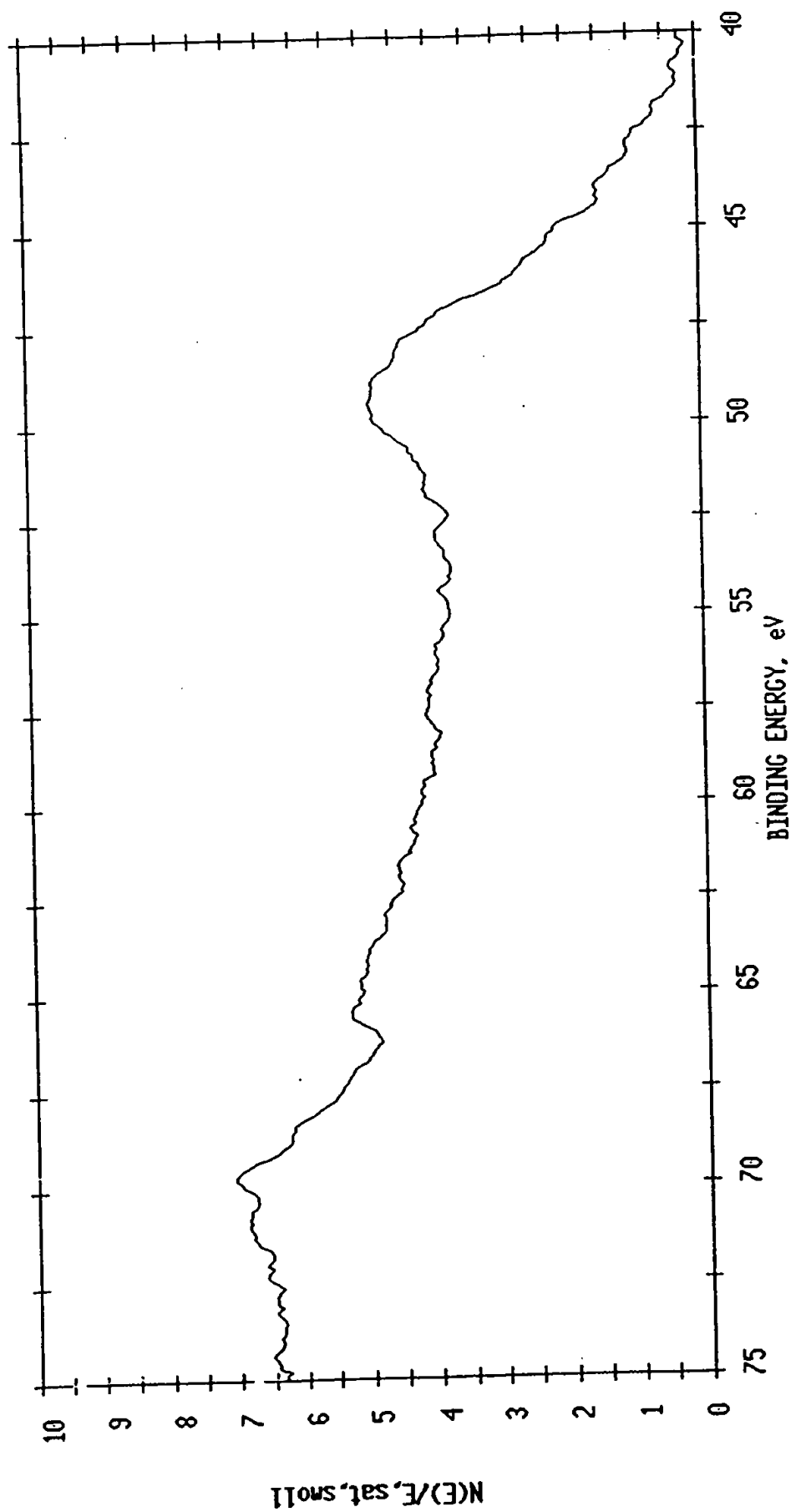
N(E)/E,sat,smo11

BINDING ENERGY, eV

Cursor

942

18374 Counts/Sec

Counts

46.700

Energy (eV)

BINDING ENERGY, eV

N(E)/E,sat,smoll,shf
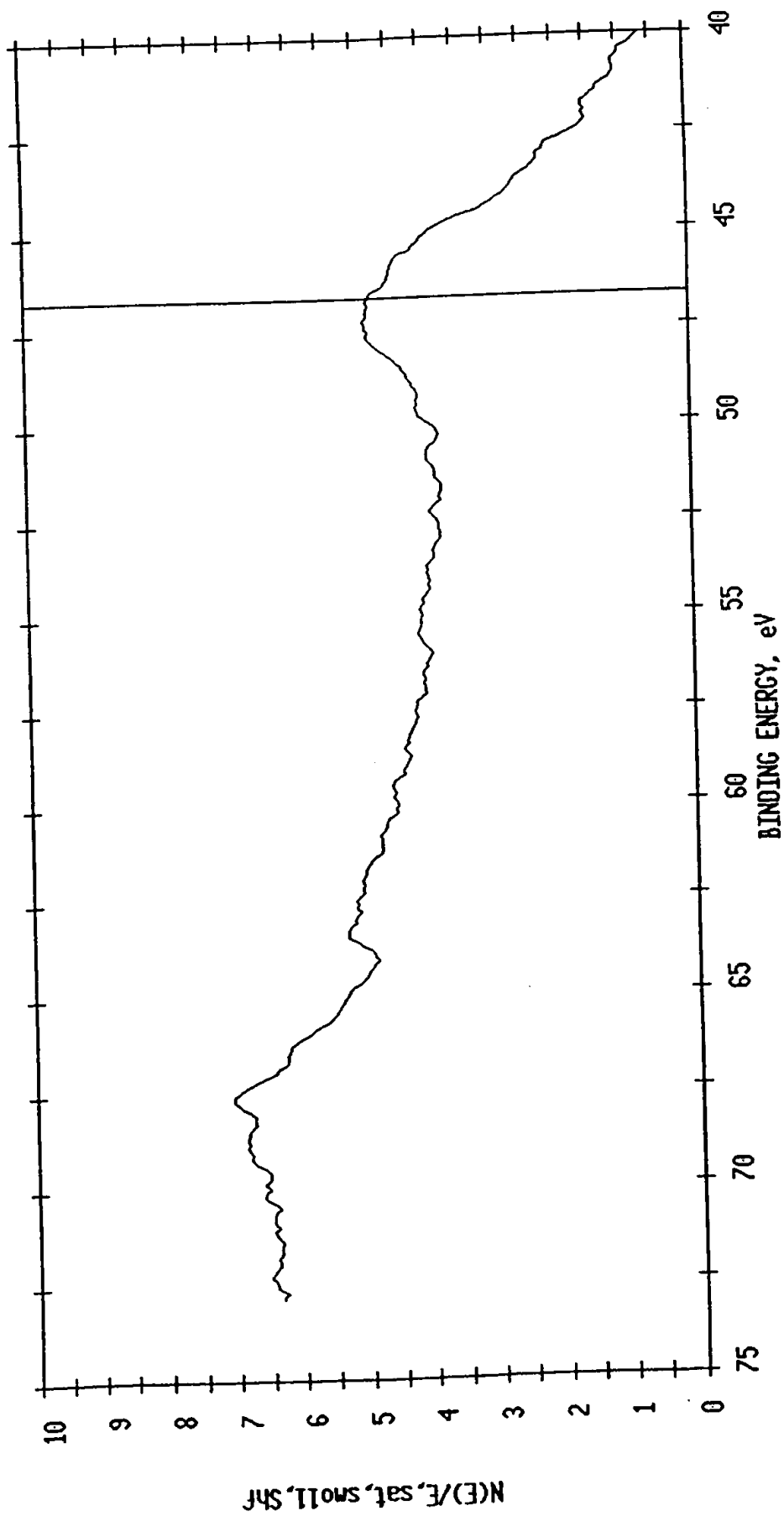
ESCA MULTIPLEX 11/23/93 EL=C1 REG 1 ANGLE= 15 deg ACQ TIME=4.19 min

FILE: Nitest42 Ni foil after treatment for 5 days.

SCALE FACTOR= 0.378 k c/s, OFFSET= 0.689 k c/s PASS ENERGY= 71.550 eV Al 400 W
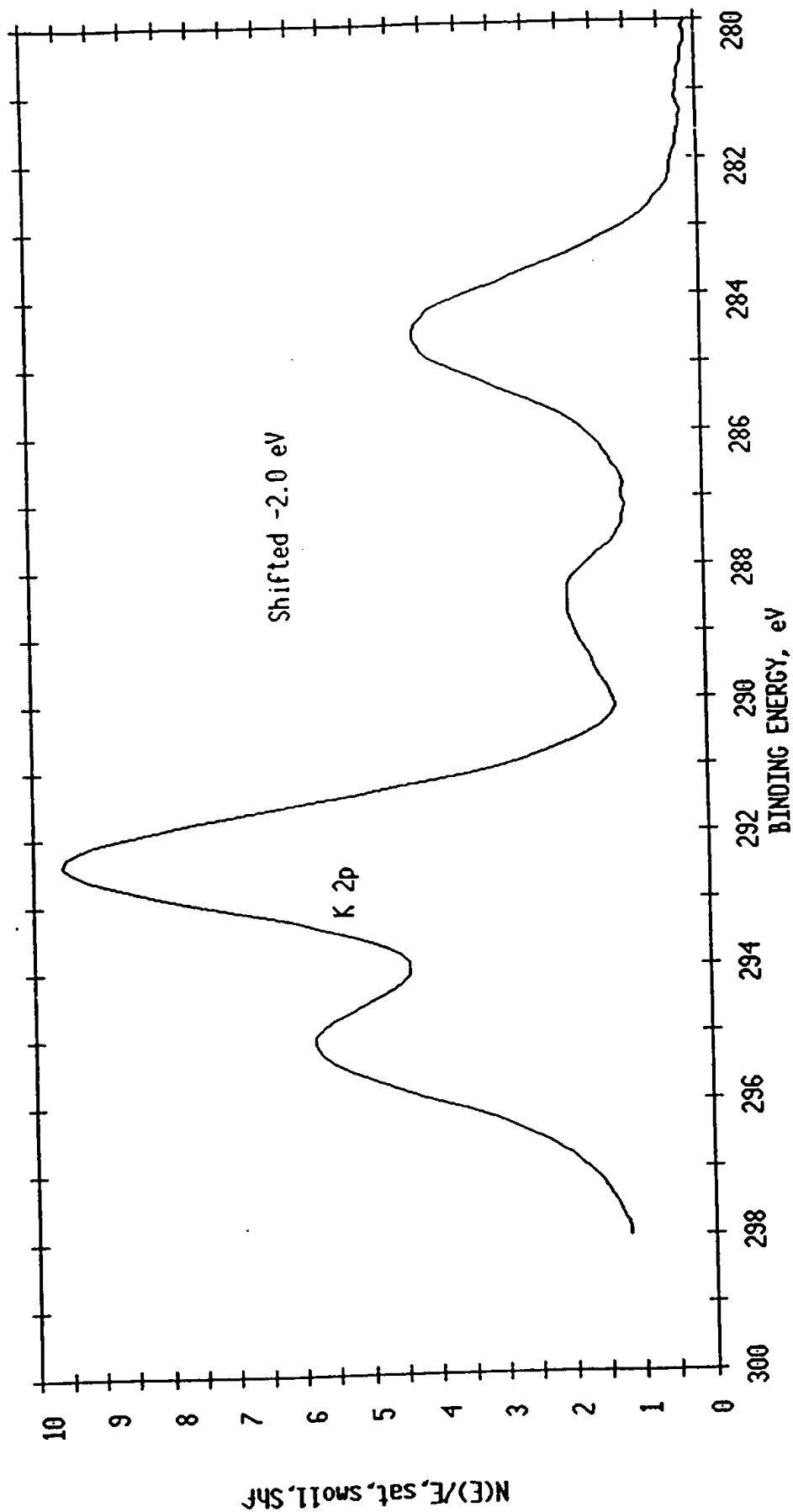
Shifted -2.0 eV

K 2p

BINDING ENERGY, eV

N(E)/E,sat,Smooth

ESCA MULTIPLEX   11/23/93   EL= REG 2 ANGLE= 15 deg ACQ TIME=609.86 min
FILE: Nitest42 Ni foil after treatment for 5 days.
SCALE FACTOR= 0.012 k c/s, OFFSET= 0.455 k c/s PASS ENERGY= 71.550 eV Al 400 W
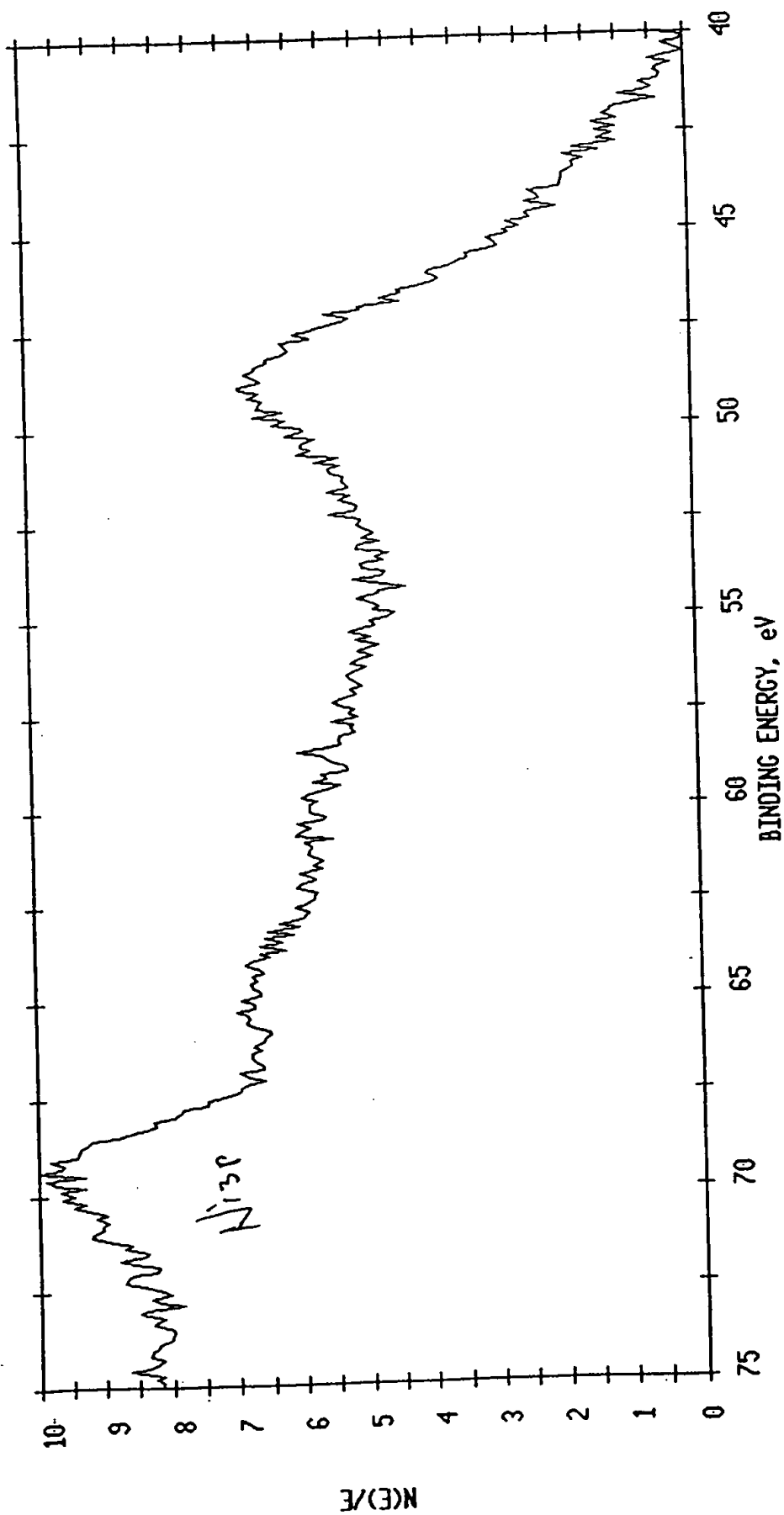
Ni3p

BINDING ENERGY, eV

N(E)/E

ESCA MULTIPLEX   11/23/93   EL= REG 2   ANGLE= 15 deg   ACQ TIME=609.86 min

FILE: Nitest42   Ni foil after treatment for 5 days.

SCALE FACTOR= 0.012 k c/s,   OFFSET= 0.403 k c/s   PASS ENERGY= 71.550 eV   Al   400 W
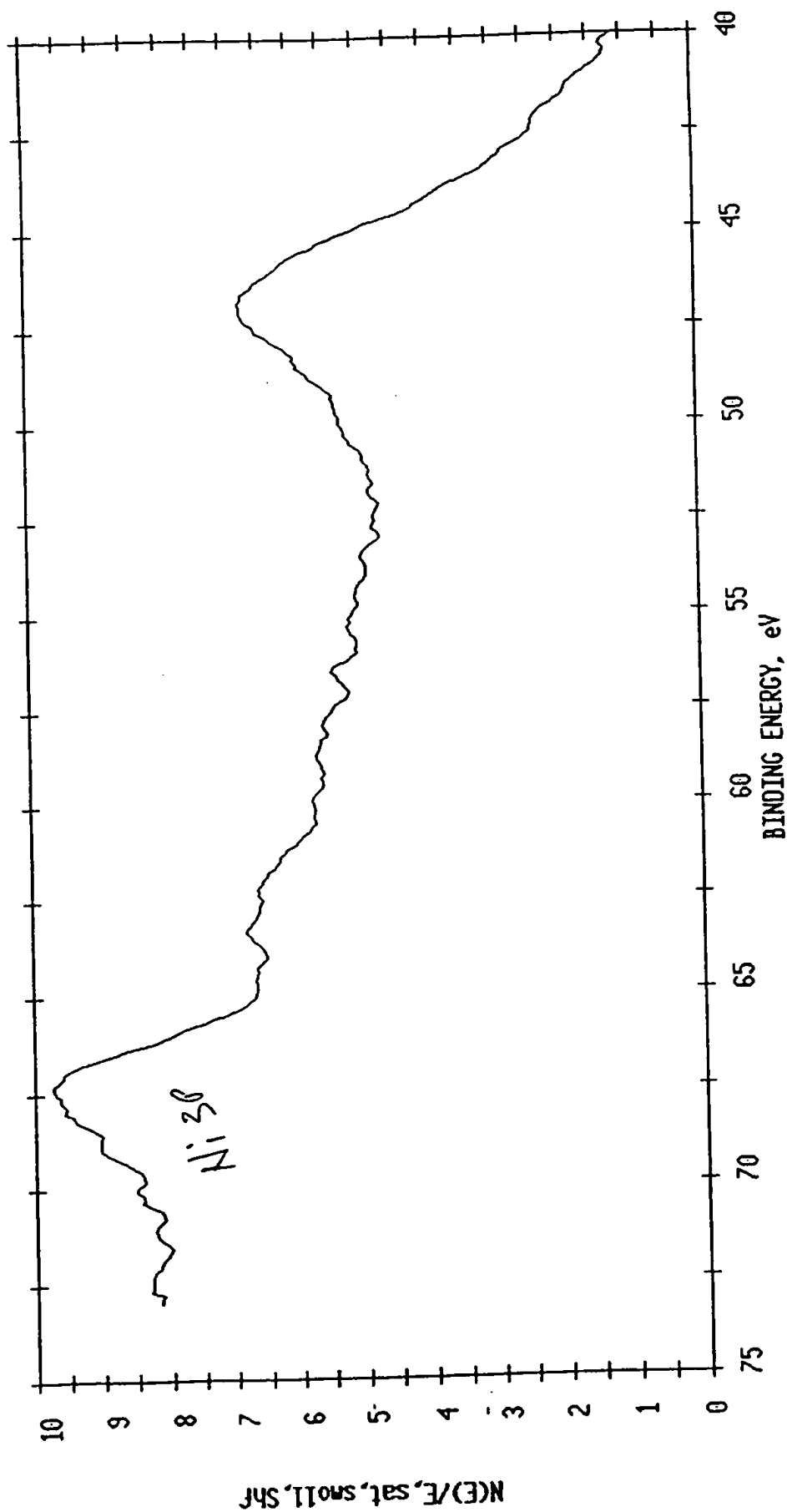
Ni 2⁸

N(E)/E,sat,smoll,shf

BINDING ENERGY, eV

Cursor

Energy (eV)   46.800   50692 Counts/Sec   486

Counts

a

N(E)/E, sat, small, shf

Ni 3p

BINDING ENERGY, eV
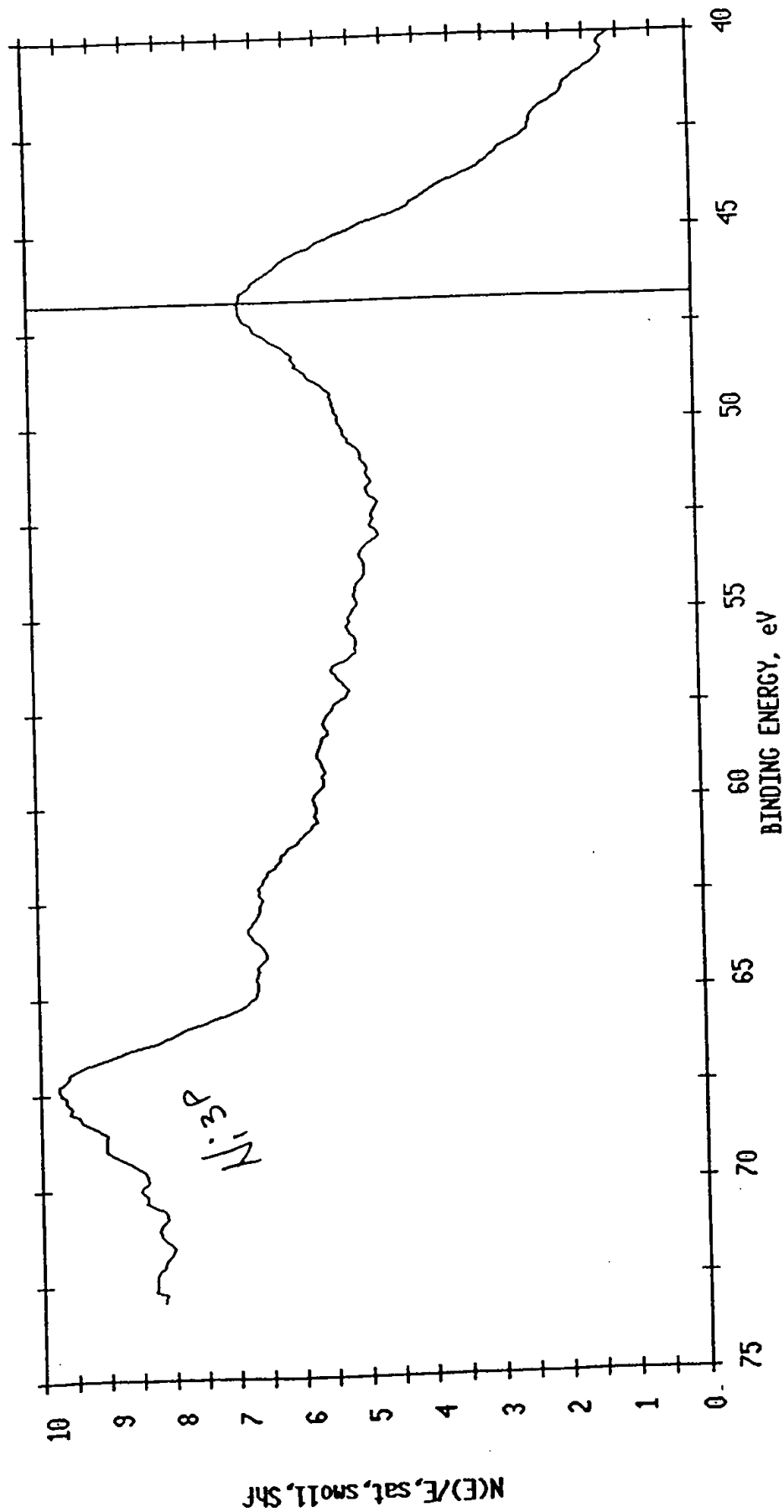
ESCA SURVEY 11/22/93 ANGLE= 15 deg ACQ TIME=29.36 min

FILE: Nitest31 Ni foil treated for 4 days (same foil as 24 hr treat.)

SCALE FACTOR= 44.544 k c/s, OFFSET= 4.987 k c/s PASS ENERGY=178.950 eV Al 400 W

Peaks labeled (from right to left): O2s Sn4d, Ni3p, Si2p - Ni3s, S2p - Si2s, Cl2p, Cl2s - K2p, N1s - K2s, Ti2p, Sn3d5 - Sn3d3, O1s, Ni LMM, Ni LMM, Ni LMM, Ni2p1 - Ni2p3, O KVV

Y-axis: N(E)/E, sat — scale 0 to 10

X-axis: BINDING ENERGY, eV — scale 0 to 1000
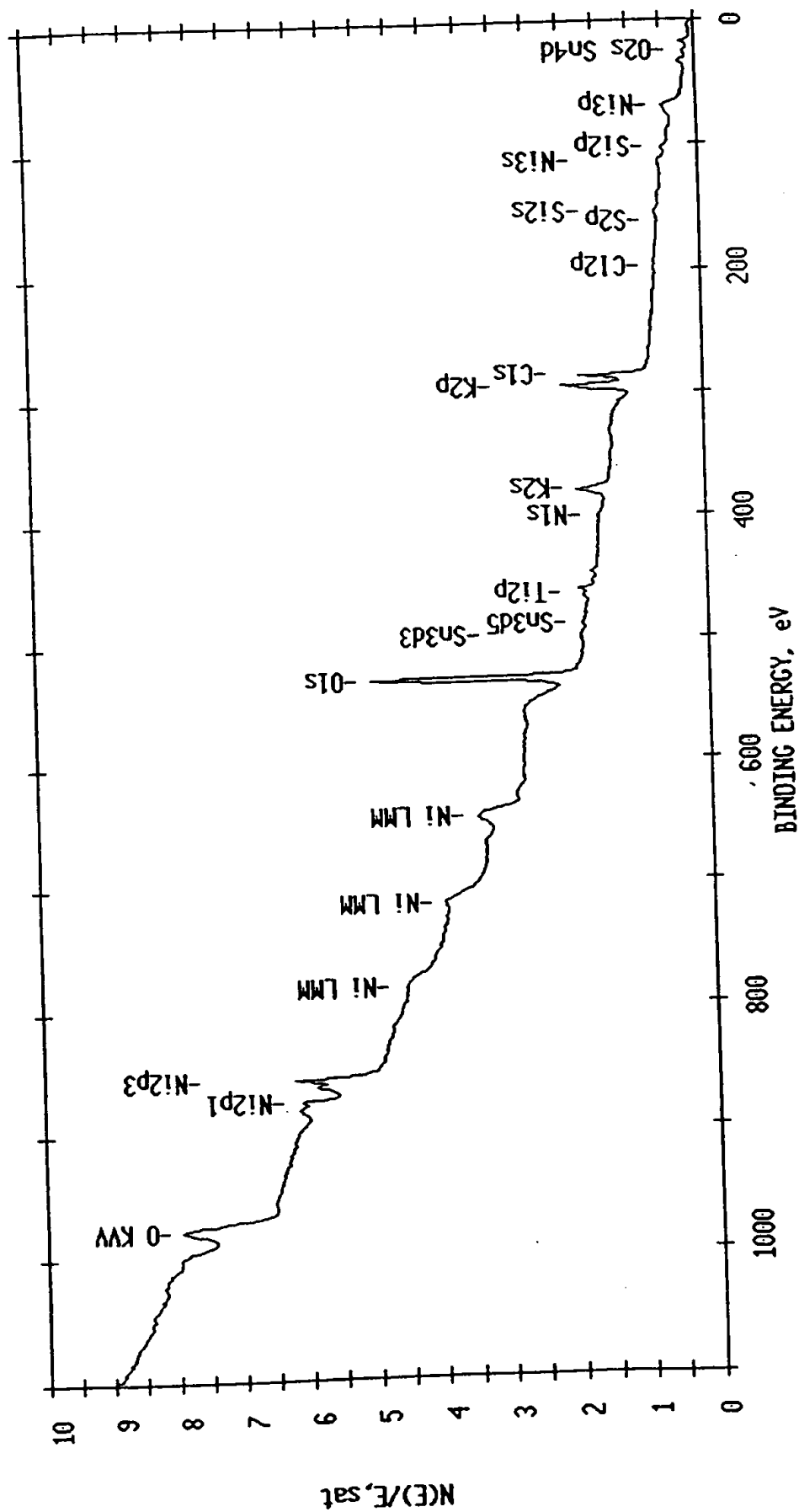
ESCA MULTIPLEX   11/22/93   EL=C1   REG 1   ANGLE= 15 deg   ACQ TIME=1.67 min
FILE: Nitest30   Ni foil treated for 4 days (same foil as 24 hr treat.)
SCALE FACTOR= 4.250 k c/s,   OFFSET= 25.454 k c/s   PASS ENERGY=143.050 eV   Al   400 W

Shifted -1.4 eV

K2p

BINDING ENERGY, eV

$N(E)/E$, sat, shf
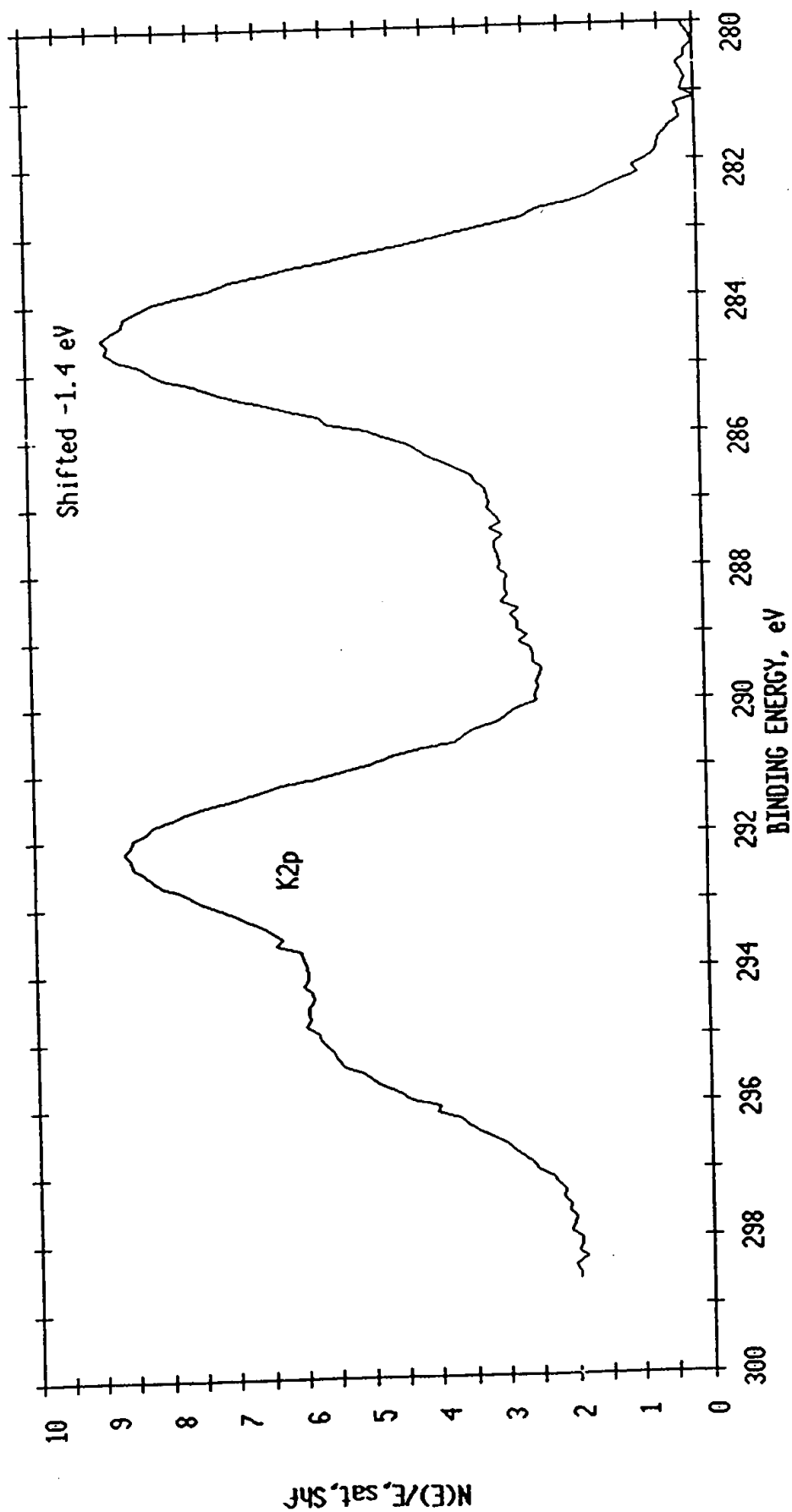
ESCA MULTIPLEX 11/22/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=46.80 min
FILE: Nitest30 Ni foil treated for 4 days (same foil as 24 hr treat.)
SCALE FACTOR= 1.109 k c/s, OFFSET= 7.432 k c/s PASS ENERGY=143.050 eV Al 400 W
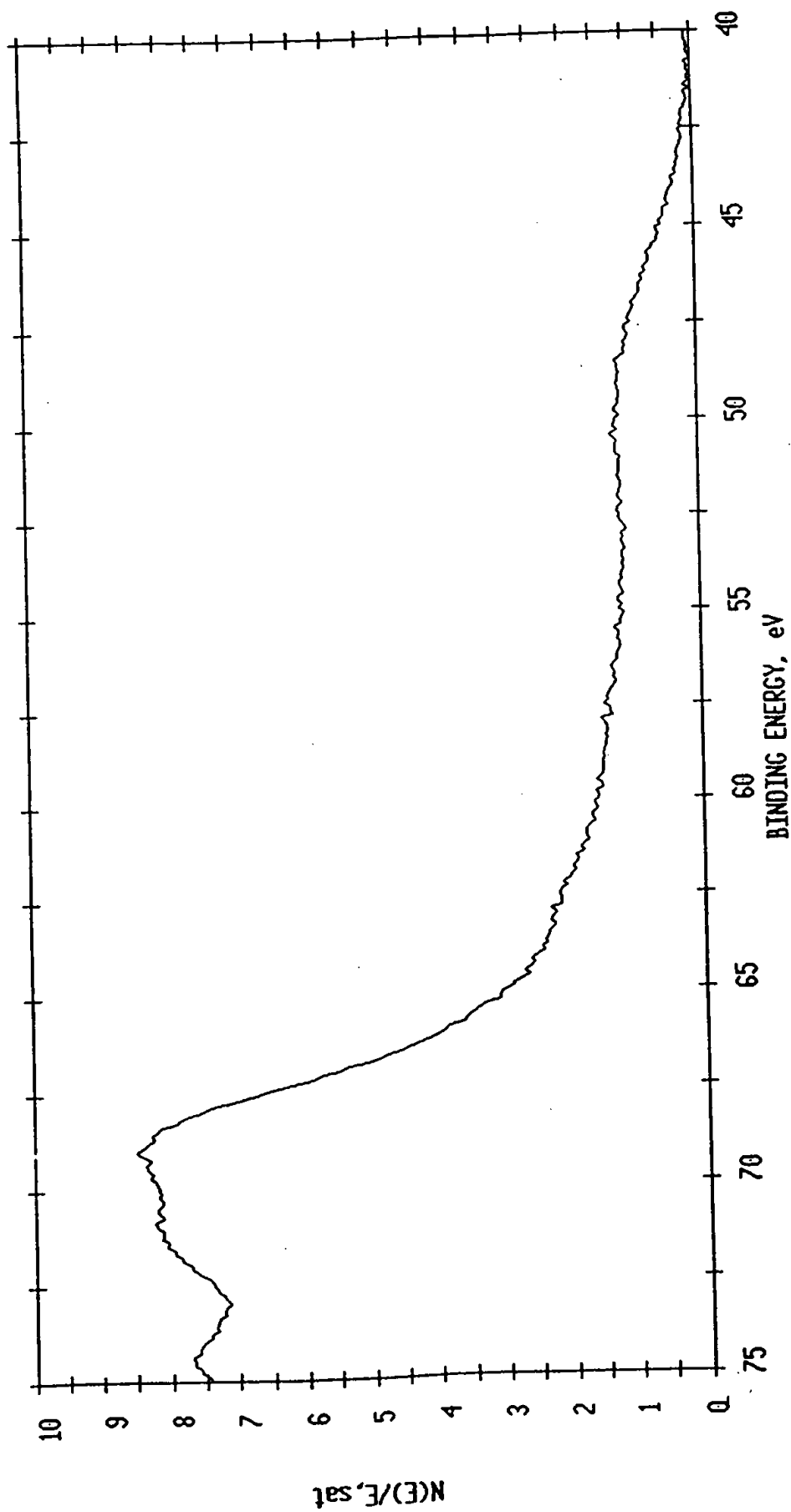
ESCA SURVEY 11/19/93 ANGLE= 15 deg ACQ TIME=29.36 min

FILE: Nitest26 Ni foil treated in lab for 24 hr. As received.

SCALE FACTOR= 64.347 k c/s, OFFSET= 8.234 k c/s PASS ENERGY=178.950 eV Al 400 W

N(E)/E, sat

BINDING ENERGY, eV

-O2s SN4d -W4f
-Ni3p
-Si2p -Ni3s
-S2p -Si2s
-B1s
-S2s
-M4d5-W4d3
-K2p-C1s
-Ca2p
-K2s
-N1s
-SN3d5-SN3d3
-O1s
-Ni LMM
-Ni LMM
-Ni LMM
-Ni2p3-Ni LMM
-Ni2p1
-O KVV

ESCA MULTIPLEX 11/19/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=84.83 min

FILE: Nitest25 Ni foil treated in lab for 24 hr. As received.

SCALE FACTOR= 1.920 k c/s, OFFSET= 8.515 k c/s PASS ENERGY=143.050 eV Al 400 W

BINDING ENERGY, eV

N(E)/E,sat
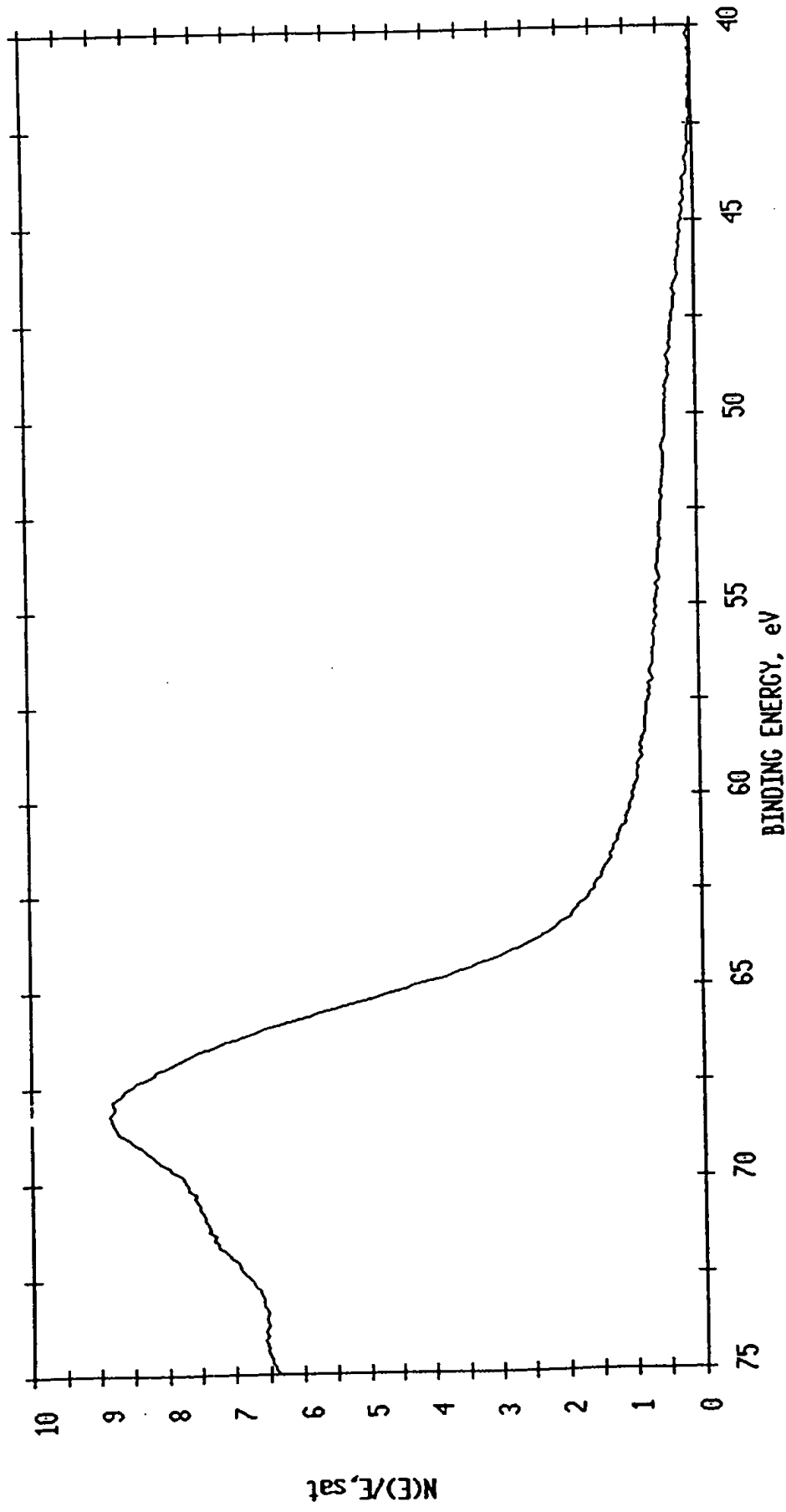
ESCA SURVEY 11/18/93 ANGLE= 15 deg ACQ TIME=29.36 min

FILE: Nitest23 Ni foil untreated. as received.

SCALE FACTOR= 80.815 k c/s, OFFSET= 11.386 k c/s PASS ENERGY=178.950 eV Al 400 H
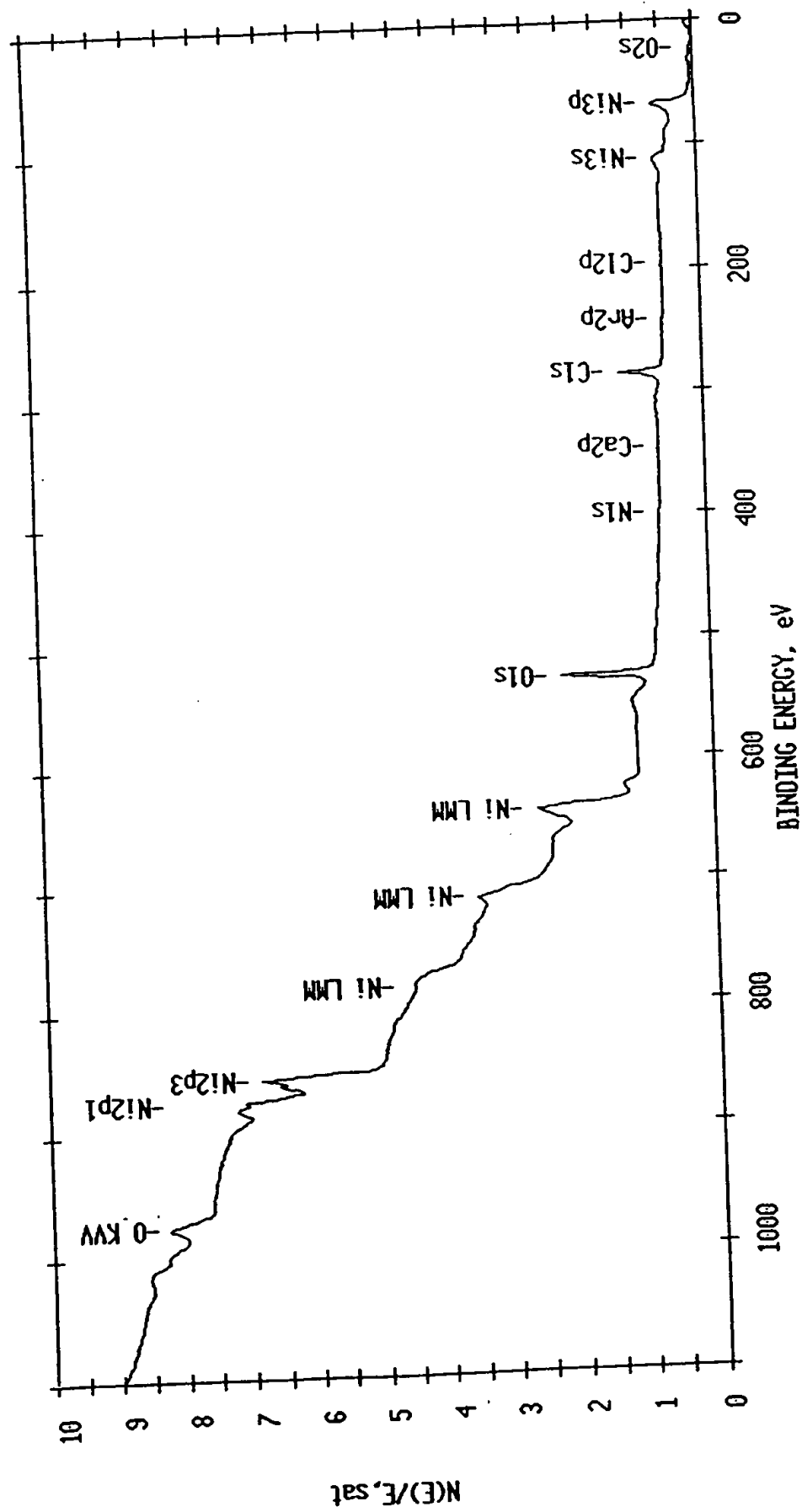
N(E)/E,sat

BINDING ENERGY, eV

—O2s
—Ni3p
—Ni3s
—Cl2p
—Ar2p
—Cls
—Ca2p
—Nls
—Ols
—Ni LMM
—Ni LMM
—Ni LMM
—Ni2pl
—Ni2p3
—O KVV

ESCA MULTIPLEX 11/18/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=76.05 min

FILE: Nitest22 Ni foil untreated. as received.

SCALE FACTOR= 3.401 k c/s, OFFSET= 9.545 k c/s PASS ENERGY=143.050 eV Al 400 W

N(E)/E,sat.shf

BINDING ENERGY, eV

10 9 8 7 6 5 4 3 2 1 0

40 45 50 55 60 65 70 75
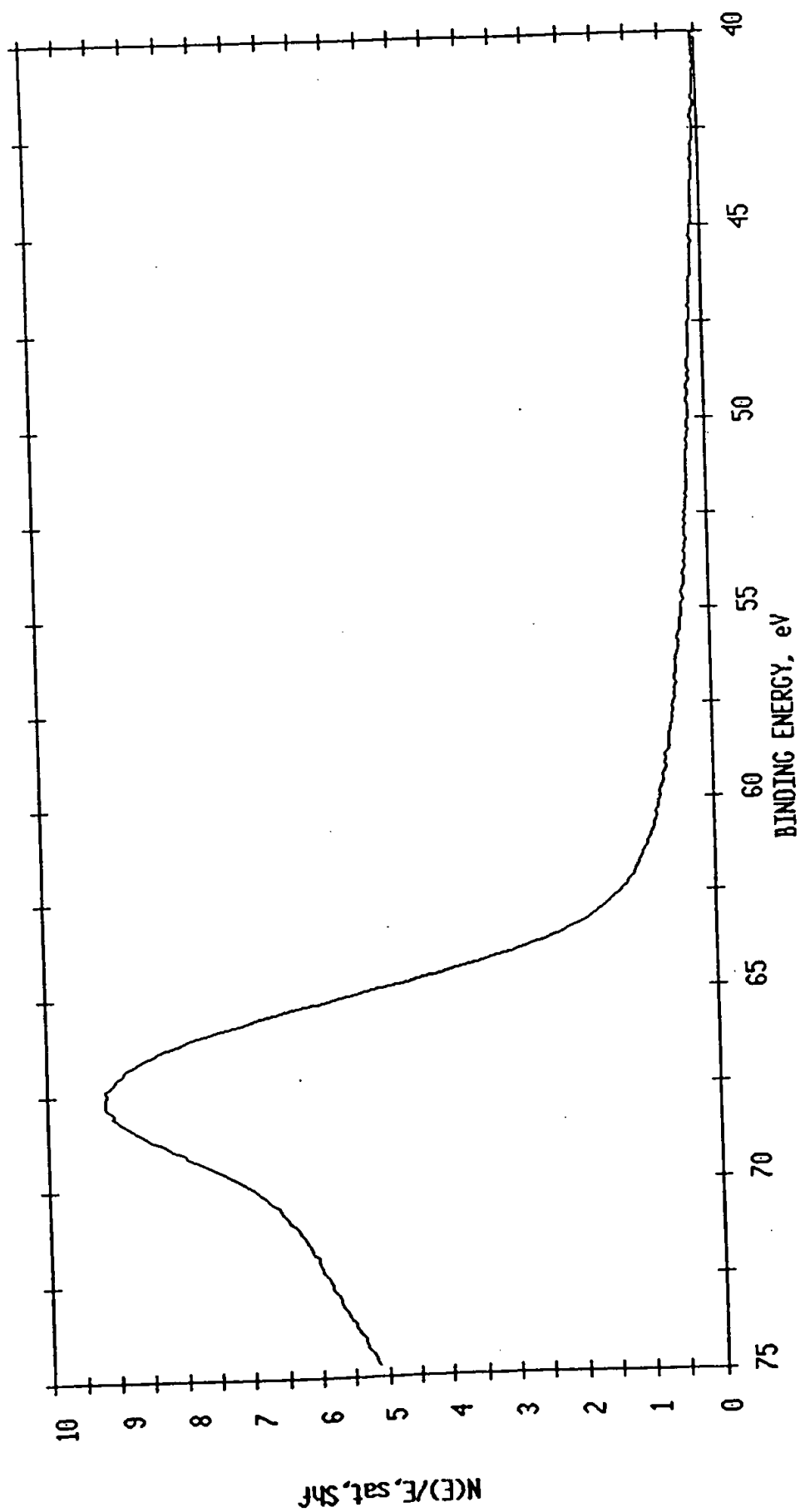
ESCA MULTIPLEX 11/18/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=76.05 min

FILE: Nitest22 Ni foil untreated. as received.

SCALE FACTOR= 3.278 k c/s, OFFSET= 10.778 k c/s PASS ENERGY=143.050 eV Al 400 W

N(E)/E

BINDING ENERGY, eV

ESCA MULTIPLEX   11/18/93   EL= REG 2   ANGLE= 15 deg   ACQ TIME=76.05 min
FILE: Nitest22   Ni foil untreated. as received.
SCALE FACTOR= 3.401 k c/s,   OFFSET= 9.545 k c/s   PASS ENERGY=143.050 eV   Al   400 W

Shift
a Initial Energy Point   284.800
b Shifted Energy Point   284.500
c Offset   -0.300
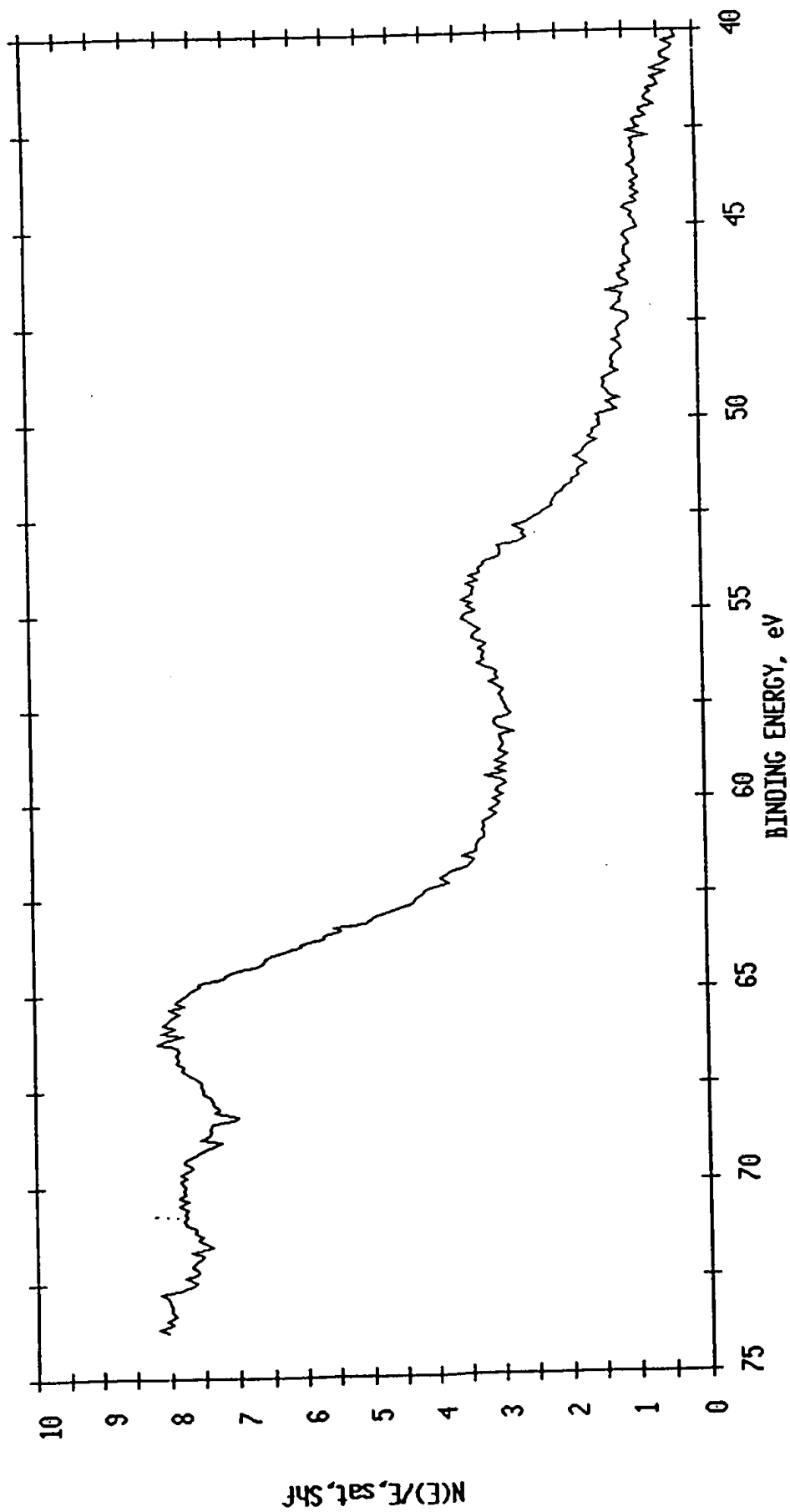
ESCA MULTIPLEX 11/18/93 EL=C1 REG 1 ANGLE= 15 deg ACQ TIME=0.84 min
FILE: Nitest22 Ni foil untreated. as received.
SCALE FACTOR= 5.007 k c/s, OFFSET= 37.388 k c/s PASS ENERGY=143.050 eV Al 400 W
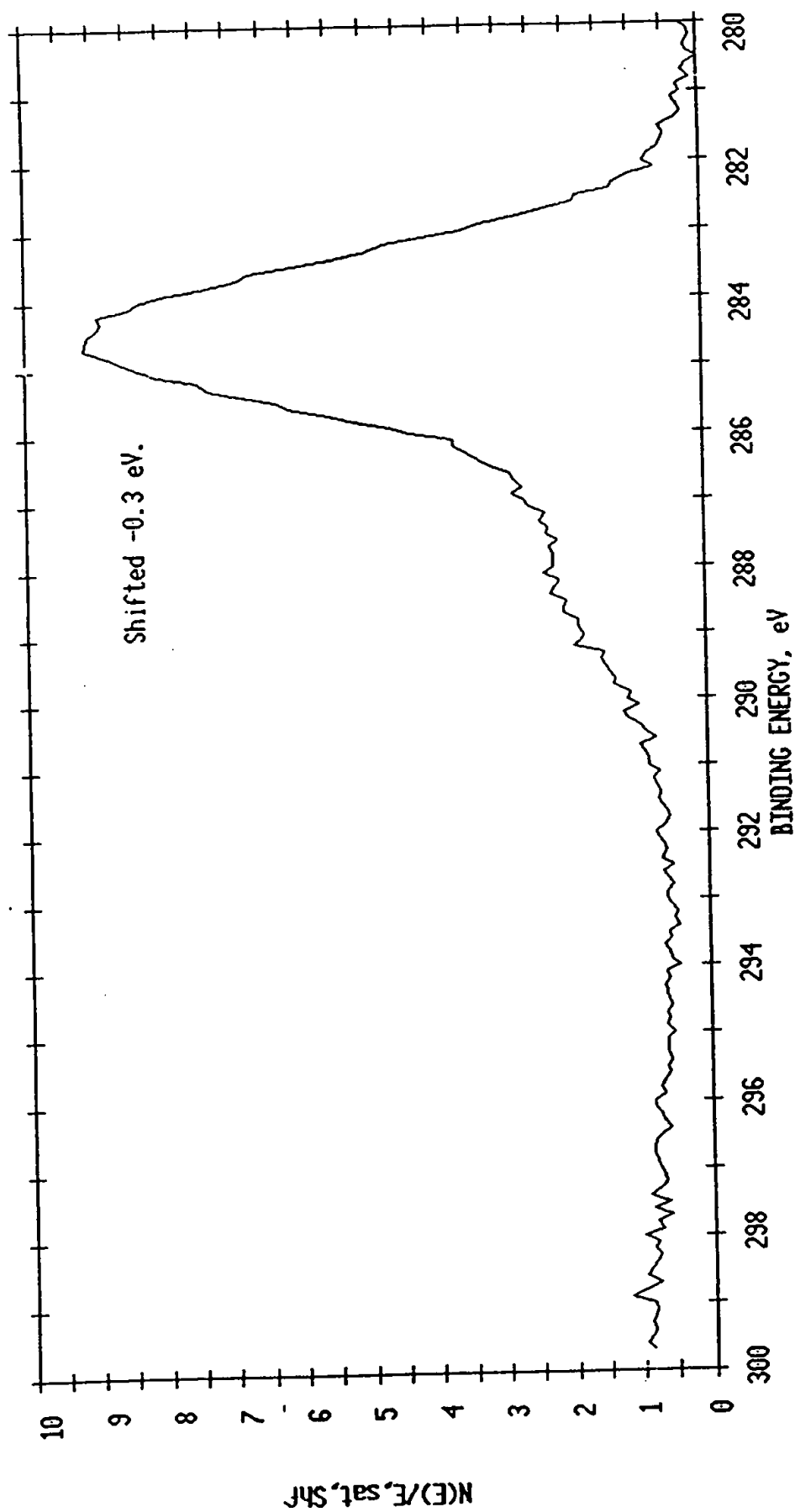
Shifted -0.3 eV.

N(E)/E,sat,Shf

BINDING ENERGY, eV

ESCA SURVEY 11/18/93 ANGLE= 15 deg ACQ TIME=29.36 min

FILE: Nitest21 Ni wire processed in lab. as received.

SCALE FACTOR= 12.496 k c/s, OFFSET= 1.542 k c/s PASS ENERGY=178.950 eV Al 400 W

N(E)/E, sat

BINDING ENERGY, eV

ESCA MULTIPLEX   11/18/93   EL= REG 2   ANGLE= 15 deg   ACQ TIME=67.28 min

FILE: Nitest20   Ni wire processed in lab. as received.

SCALE FACTOR= 0.301 k c/s, OFFSET= 2.742 k c/s   PASS ENERGY=143.050 eV   Al   400 W

BINDING ENERGY, eV

N(E)/E

ESCA MULTIPLEX 11/18/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=67.28 min

FILE: Nitest20 Ni wire processed in lab. as received.

SCALE FACTOR= 0.280 k c/s, OFFSET= 2.436 k c/s PASS ENERGY=143.050 eV Al 400 W

File N: total U
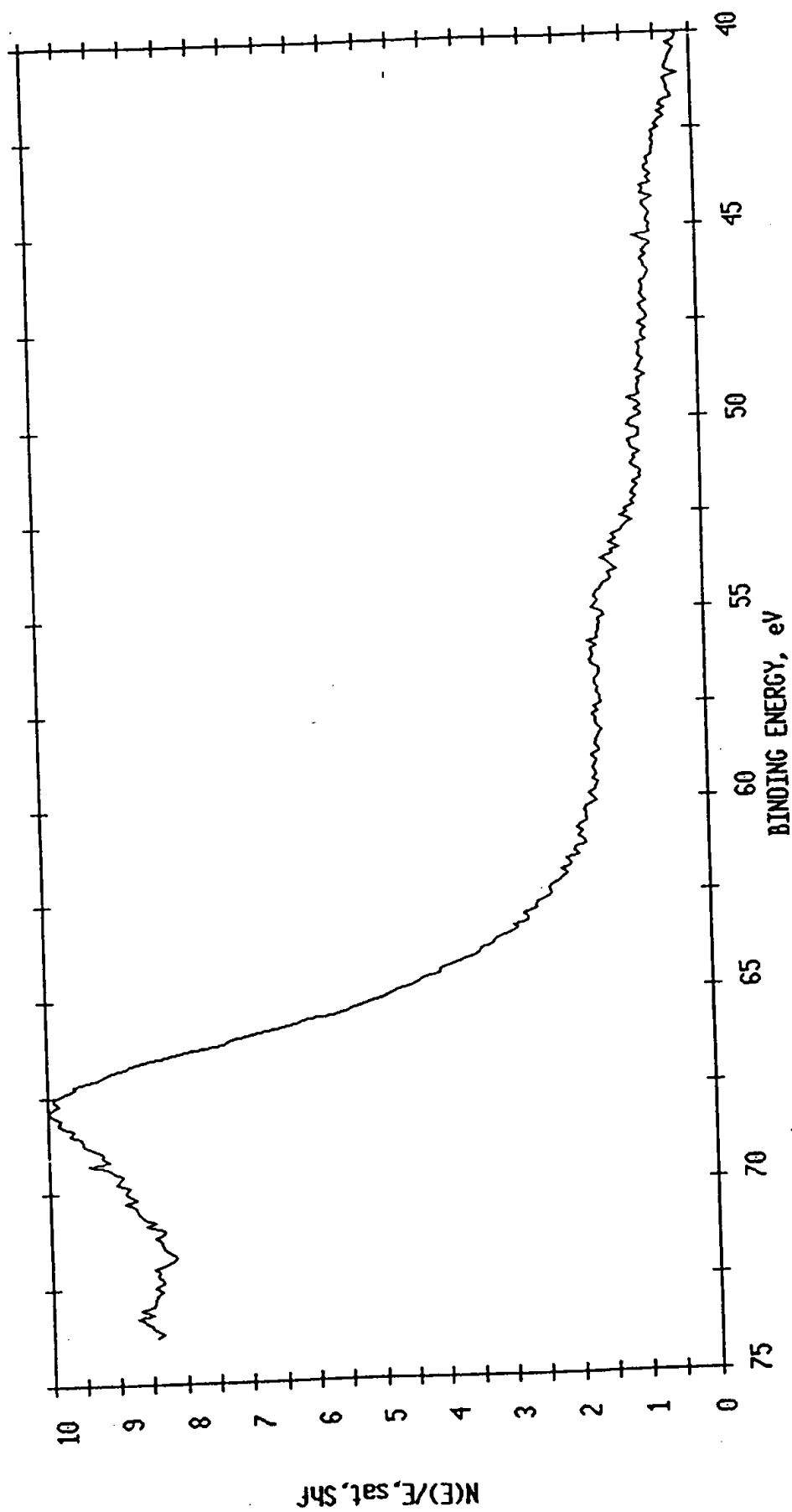
Shift
285.700
284.500
-1.200

a Initial Energy Point
b Shifted Energy Point
c Offset

BINDING ENERGY, eV

N(E)/E,sat
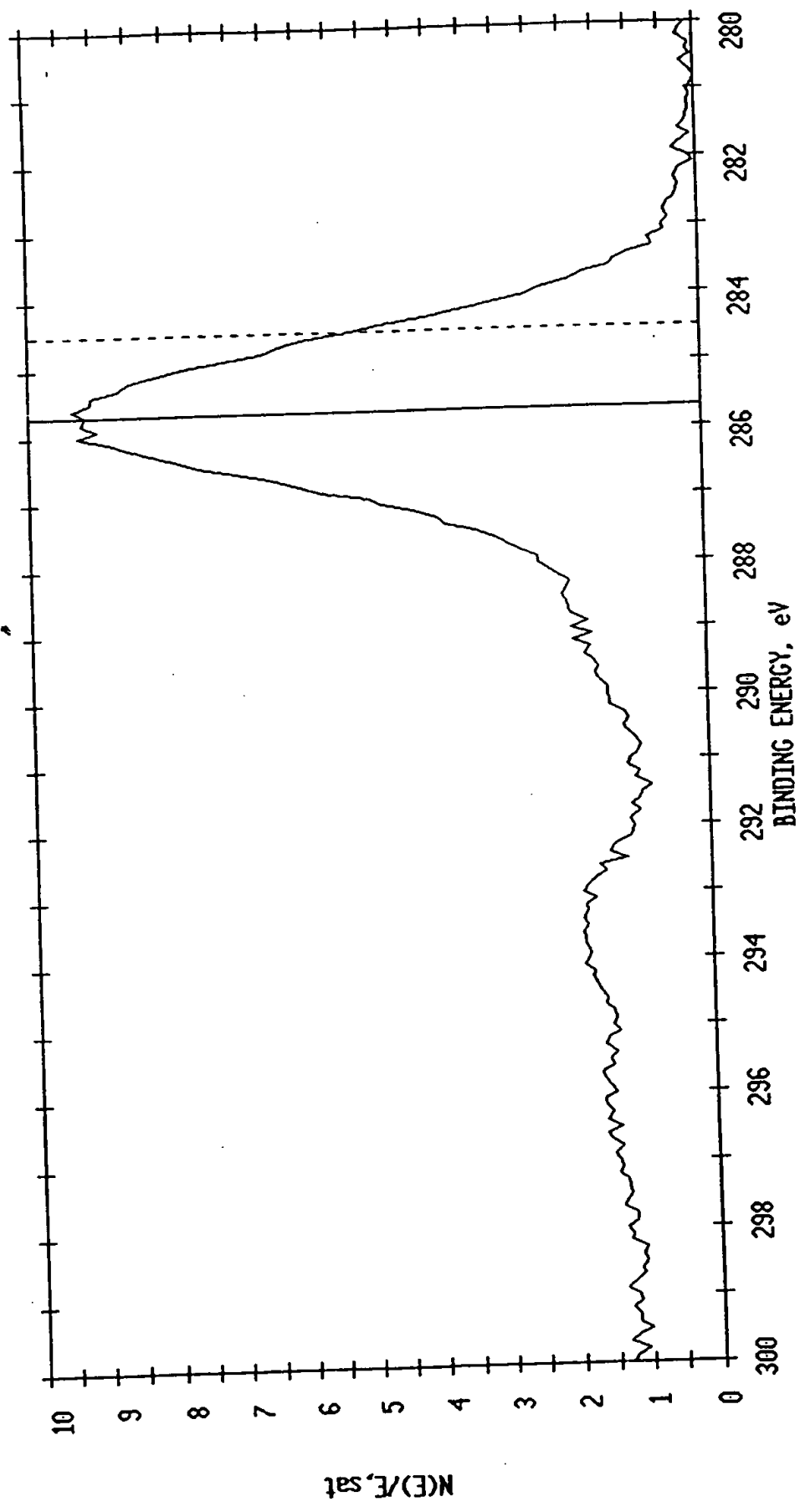
ESCA MULTIPLEX 11/18/93 EL=C1 REG 1 ANGLE= 15 deg ACQ TIME=1.67 min
FILE: Nitest20 Ni wire processed in lab. as received.
SCALE FACTOR= 1.789 k c/s, OFFSET= 8.206 k c/s PASS ENERGY=143.050 eV Al 400 W
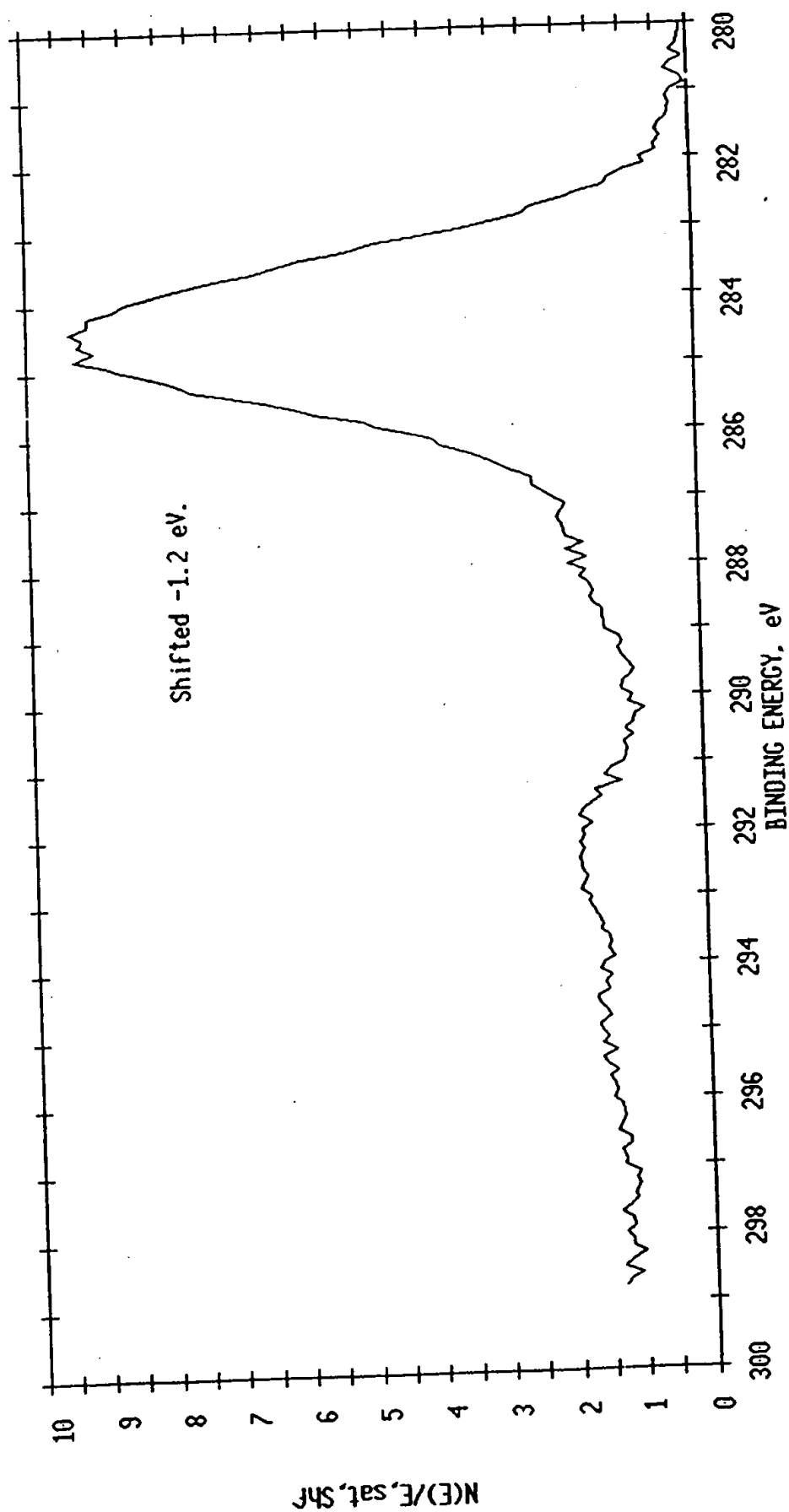
Shifted -1.2 eV.

N(E)/E,sat,shf

BINDING ENERGY, eV

ESCA SURVEY 11/22/93 ANGLE= 15 deg ACQ TIME=29.36 min
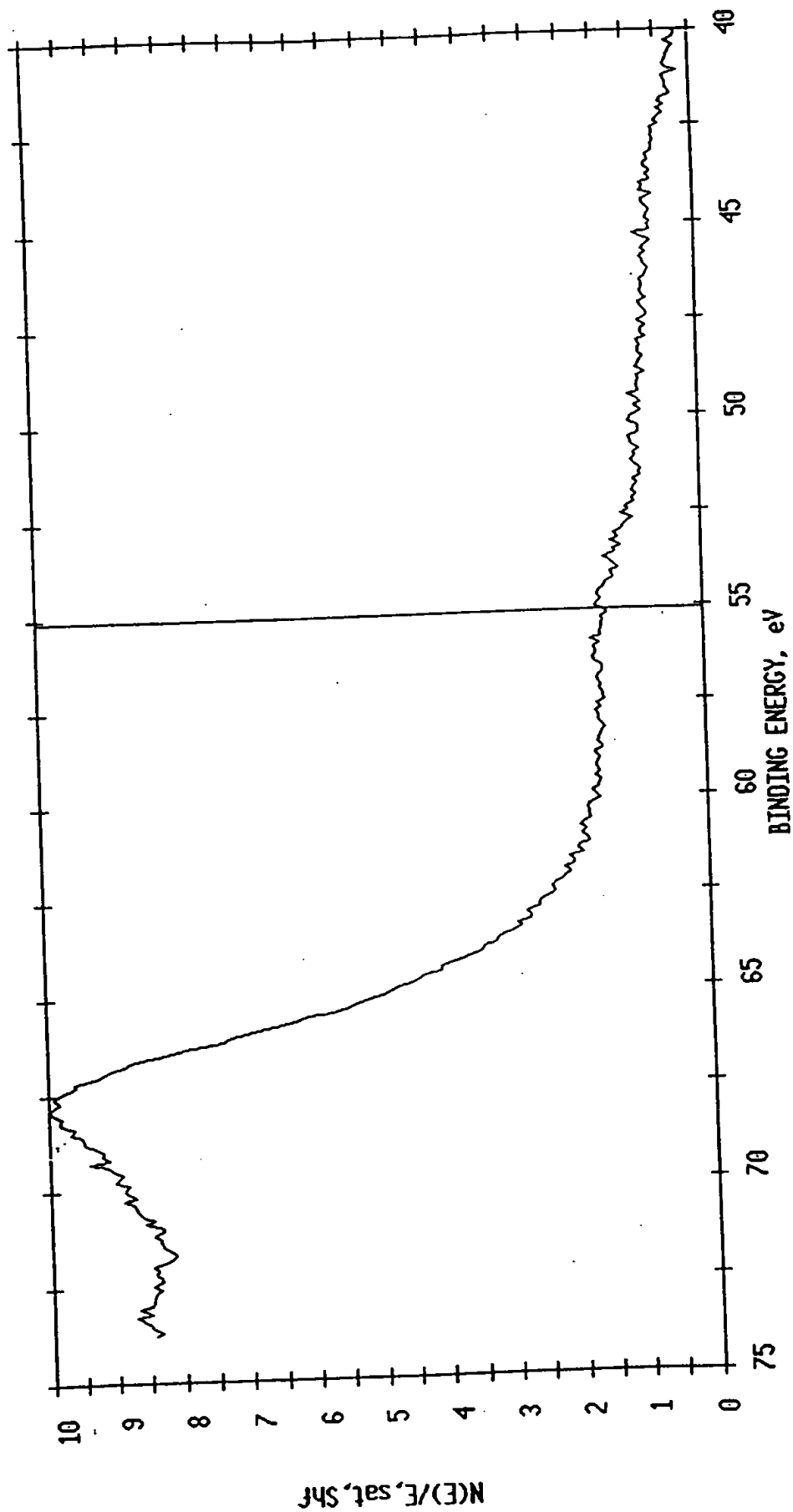
FILE: Nitest33 2nd Ni wire treated prior to IRC.

SCALE FACTOR= 11.123 k c/s, OFFSET= 1.299 k c/s PASS ENERGY=178.950 eV Al 400 W
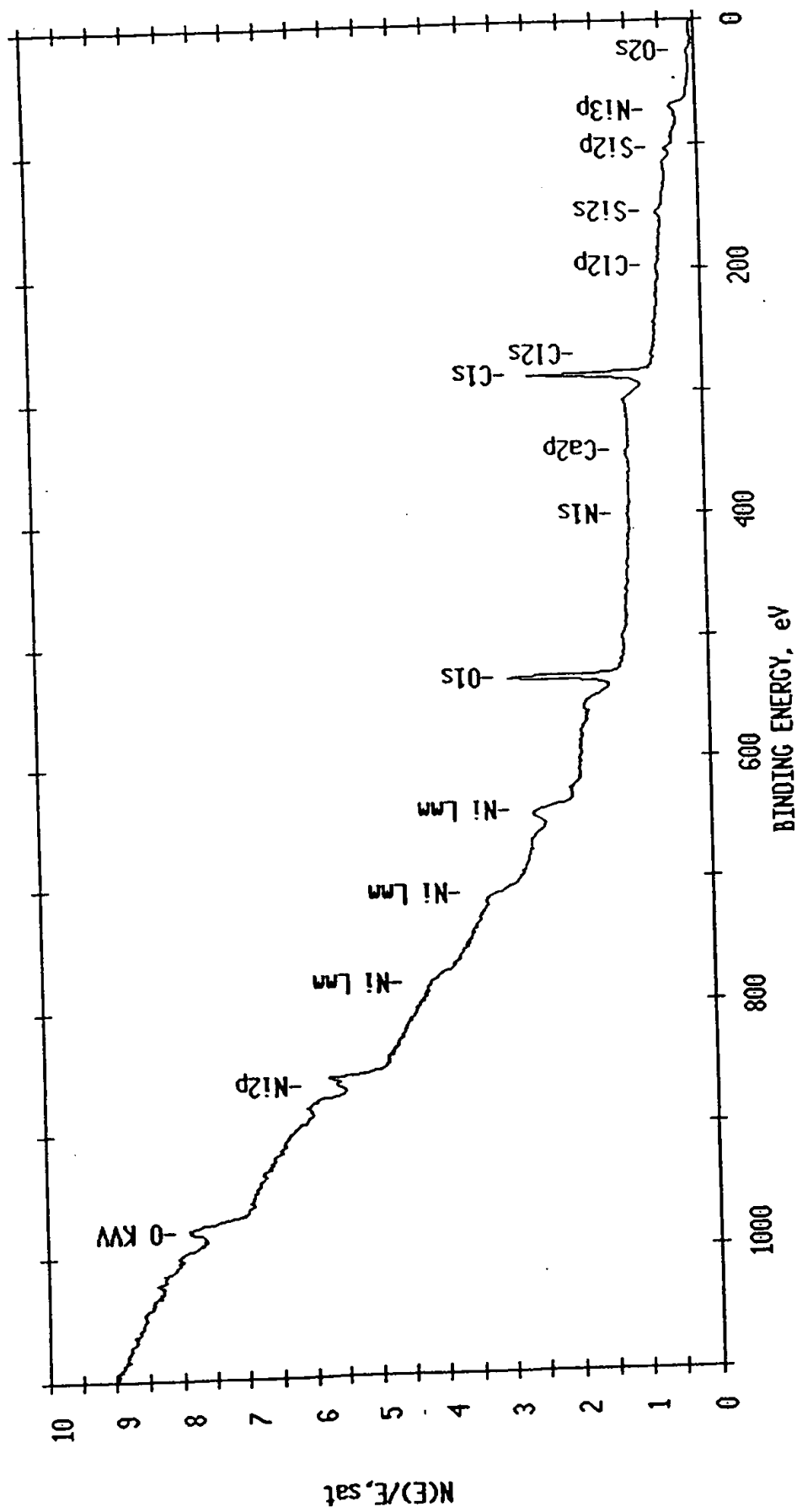
ESCA MULTIPLEX 11/22/93 EL=C1 REG 1 ANGLE= 15 deg ACQ TIME=1.67 min
FILE: Nitest32 2nd Ni wire treated prior to IRC.
SCALE FACTOR= 1.491 k c/s, OFFSET= 5.842 k c/s PASS ENERGY=143.050 eV Al 400 W
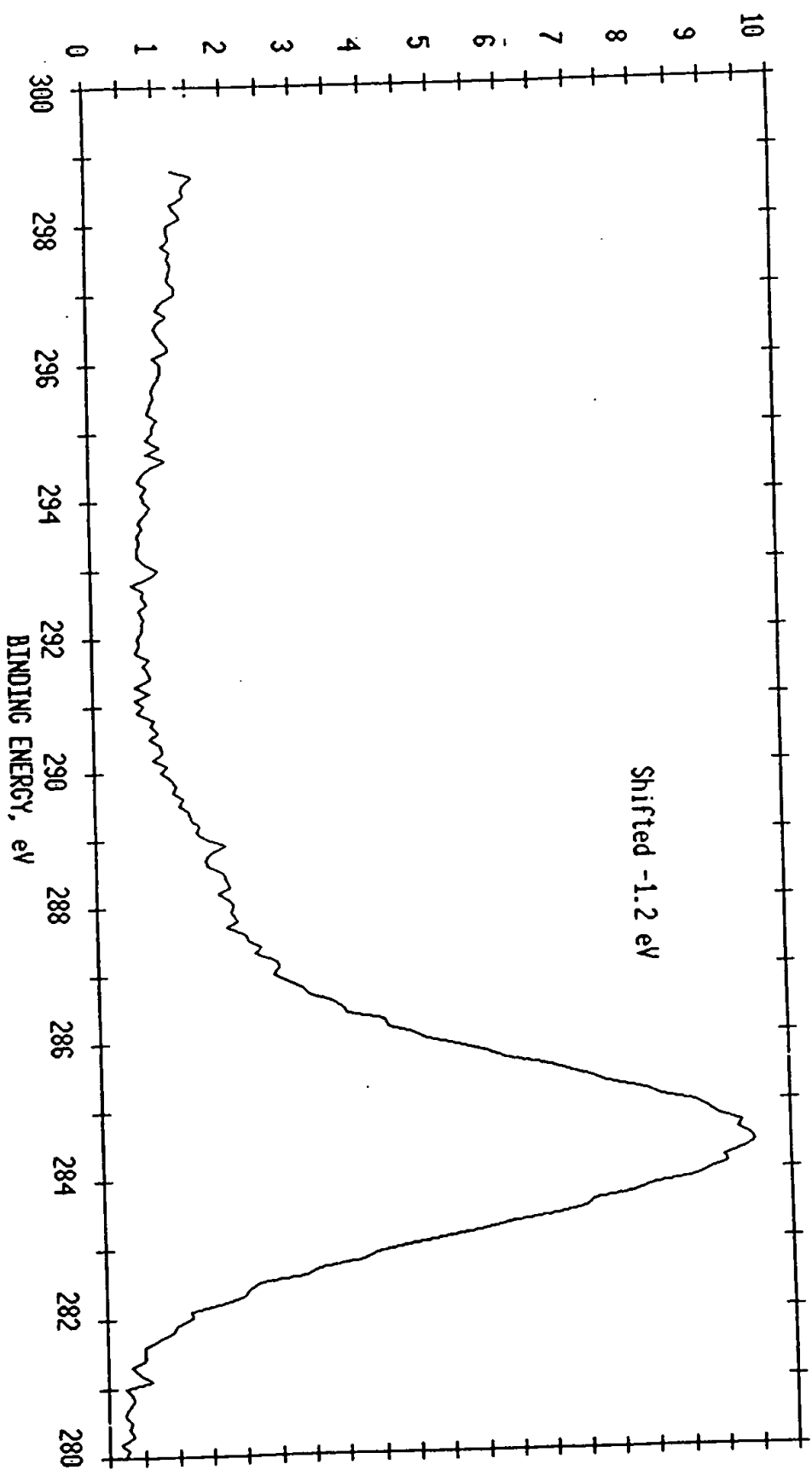
Shifted -1.2 eV

N(E)/E, sat, Shf

BINDING ENERGY, eV

ESCA MULTIPLEX 11/22/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=96.53 min
FILE: Nitest32 2nd Ni wire treated prior to IRC.
SCALE FACTOR= 0.254 k c/s, OFFSET= 1.784 k c/s PASS ENERGY=143.050 eV Al 400 W

N(E)/E

BINDING ENERGY, eV

ESCA MULTIPLEX 11/18/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=67.28 min
FILE: Nitest20 Ni wire processed in lab. as received.
SCALE FACTOR= 0.331 k c/s, OFFSET= 2.436 k c/s PASS ENERGY=143.050 eV Al 400 W

ESCA MULTIPLEX 11/19/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=84.83 min
FILE: Nitest25   Ni foil treated in lab for 24 hr. As received.
SCALE FACTOR= 1.920 k c/s, OFFSET= 8.515 k c/s PASS ENERGY=143.050 eV Al 400 W

Ni foils before and after treatment.

N(E)/E,sat

10 9 8 7 6 5 4 3 2 1 0

75   70   65   60   55   50   45   40

BINDING ENERGY, eV

ESCA MULTIPLEX 11/18/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=76.05 min
FILE: Nitest22 Ni foil untreated. as received.
SCALE FACTOR= 3.401 k c/s, OFFSET= 9.545 k c/s PASS ENERGY=143.050 eV Al 400 W

Processed Ni wire and unprocessed Ni foil.

N(E)/E, sat. Shf

BINDING ENERGY, eV

ESCA MULTIPLEX 11/18/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=67.28 min
FILE: Nitest20 Ni wire processed in lab. as received.
SCALE FACTOR= 0.331 k c/s, OFFSET= 2.436 k c/s PASS ENERGY=143.050 eV Al 400 W

Treated and untreated Ni wire

N(E)/E,sat,Shf

BINDING ENERGY, eV

ESCA MULTIPLEX   11/19/93   EL= REG 2   ANGLE= 15 deg   ACQ TIME=61.43 min
FILE: Nitest27   Ni wire untreated (base line) using Al X-Ray's.
SCALE FACTOR= 0.326 k c/s,   OFFSET= 1.491 k c/s   PASS ENERGY=143.050 eV   Al   400 W

ESCA MULTIPLEX 11/22/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=96.53 min

FILE: Nitest32 2nd Ni wire treated prior to IRC.

SCALE FACTOR= 0.274 k c/s, OFFSET= 1.580 k c/s PASS ENERGY=143.050 eV Al 400 W

N(E)/E,sat

BINDING ENERGY, eV

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Lee, Jang-Jung, Charles Evans & Associates Time-Of-Flight Secondary Ion Mass Spectroscopy (TOF-SIMS) Surface Analysis Report, CE&A Number 40150, March 18, 1994

CHARLES EVANS & ASSOCIATES

Time of Flight-Secondary Ion Mass Spectroscopy Report

Company's Summary of the Charles Evans Results

Lehigh University has conducted an extensive investigation of the cathodes from heat producing as well as those from control cells and has determined that the results lend some support to Mills' theory. See Exhibit 6- Lehigh University XPS Report.

The XPS results were confirmed at National Laboratory A followed by Time of Flight-Secondary Ion Mass Spectroscopy (TOF-SIMS) analysis of the nickel surface. Iron and lithium were the only remaining atoms which were in question by Lehigh University and National Laboratory A as the source of the 54.6 eV XPS peak. The Charles Evans TOF-SIMS results demonstrate that iron and lithium were not the source of this peak. TOF-SIMS is orders of magnitude more sensitive in the identification of the presence of a given atom as compared to XPS. TOF-SIMS of Samples #1, #2, #3,#4 showed that no lithium was detected. TOF-SIMS of Sample 1# and Sample #2 showed that iron was at the detection limit which was far less than the amount required for an observable signal by XPS. TOF-SIMS of Sample #3, the control virgin nickel tube, contained six times the iron as Sample #4, but no 54.6 eV XPS peak was observed in the case of Sample #3. Therefore, iron was eliminated as the source of the 54.6 eV XPS peak of Sample #4. See Exhibit 7-Charles Evans Time of Flight-Secondary Ion Mass Spectroscopy Report.

The descriptions of the samples sent to Charles Evans & Associates by National Laboratory A are as follows:

Sample #1
This sample is Sample # 9 of Lehigh University shown in Figure 34 of the Lehigh University XPS Report which is attached. The XPS was also performed on this sample at National Laboratory A. The survey spectrum is shown as Nitest21 which is attached. The spectrum in the region of 55 eV is shown as Nitest20 which is attached.

Sample #2

Electrolysis followed by XPS was performed at National Laboratory A. The cathode comprised approximately 60 cm of 0.38 mm diameter nickel wire (99 % Alfa # 10249, cold drawn, clean Ni wire) that was cleaned by placing it in a beaker of 0.57 M K_2CO_3 /3% H_2O_2 for 10 hours and then rinsing them with distilled water. The anode comprised a 5 cm by 5 cm platinized titanium mesh. The electrolyte solution was 0.57 M aqueous K_2CO_3 (Aldrich $K_2CO_3 * \frac{3}{2} H_2O$ 99+%). Electrolysis was performed with a constant current of 8 milliamps which corresponded to approximately 0.5 milliamp per square centimeter for 24 hours. The cathode was removed and rinsed with distilled water followed by XPS analysis. The spectrum in the region of 55 eV is shown as Nitest50 which is attached.

Sample #3

This sample was the virgin nickel tubing of the gas permeation cell fabricated and tested by Thermacore, Inc. which produced 50 watts of power at 300 °C having a nickel surface area of only 300 cm^2. See Exhibit 13- Shaubach, R., Gernert, N. J., "Measurement of excess heat from nascent hydrogen with potassium carbonate on nickel without electrolysis", Phys. Letts. A, in progress. The XPS spectrum performed at Lehigh University is shown in Figure 4 which is attached. The same spectrum of this sample was also obtained at National Laboratory A.

Sample #4

This sample was the nickel tubing following the production of energy of the gas permeation cell fabricated and tested by Thermacore, Inc. The cell produced 50 watts of power at 300 °C having a nickel surface area of only 300 cm^2. See Exhibit 13- Shaubach, R., Gernert, N. J., "Measurement of excess heat from nascent hydrogen with potassium carbonate on nickel without electrolysis", Phys. Letts. A, in progress. The XPS spectrum performed at Lehigh University is shown in Figure 4 which is attached. The same spectrum of this sample was also obtained at National Laboratory A.

CHARLES EVANS & ASSOCIATES

SPECIALISTS IN MATERIALS CHARACTERIZATION

March 18, 1994

Michael Jacox
EG&G Idaho, Inc.
Bldg. CF-601
Idaho National Engineering Laboratory
Scoville, Idaho 83415
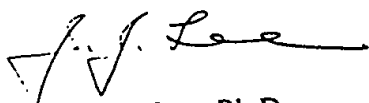
Subject: TIME-OF-FLIGHT SECONDARY ION MASS SPECTROMETRY (TOF-SIMS)
           SURFACE ANALYSIS REPORT
           CE&A Number: 40150
           Purchase Order Number:

Dear Mr. Jacox:

Enclosed is the original copy of the fax report that was sent to you. I believe that the color images in this orginal copy will be more useful to you

If you have any questions please do not hesitate to contact me.

Sincerely,

Jang-Jung Lee, Ph.D.
Staff Analyst
Organic Surface Analysis

Enclosures

CHARLES EVANS & ASSOCIATES

SPECIALISTS IN MATERIALS CHARACTERIZATION

COMPANY: EG&G Idaho Inc.

ATTENTION: Michael Jacox

DESTINATION
FAX NO: (208) 526-2061

FROM: J.J. Lee

SUBJECT: TOF-SIMS Analysis

REF NO:

DATE: March 18, 1994

PAGE 1 OF 16

CE&A REPLY FAX
NO: (415) 369-7921

(CE&A No. 40150)

Here are the results from your Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS) analysis.

Purpose: To obtain mass spectra from two Ni wires, Sample # 1 and 2, and two Ni tubes, Sample # 3 and 4. Elemental contamination in the near surface layer (< 30 nm) is of interest.

Experimental: TOF-SIMS mass spectra were acquired on the Charles Evans and Associates TFS system. Spectra were obtained using a gallium liquid metal ion gun (LMIG) primary ion source. The instrument was operated in an ion microprobe mode in which the pulsed primary ion beam was rastered across the sample's surface, permitting the imaging mode analysis of small features. Typical primary ion doses were on the order of 10^{12} ions/cm^2.

Results: The data are reported as mass spectra and ion images. Spectra are plotted as the number of secondary ions detected (Y-axis) versus the mass-to-charge (m/z) ratio of the ions (X-axis). The ion counts are displayed on logarithmic or linear intensity scales, and probable empirical formulae for a number of the peaks are labeled on the plots. Ion images present the integrated intensities of mass selected ions within the field of view as a function of picture element, or pixel, position.

General material about the interpretation of TOF-SIMS spectra is included at the end of the report.

Discussion: The positive ion spectra of the four samples are included in Figures 1 to 10. Figures 4 to 10 contain expanded plots for various mass ranges to delineate different elemental ion peaks. In each page the spectra from the top panel are for Samples #1, #2, #3 and #4. All the spectra were acquired after a short sputter clean to remove possible surface contamination.

The spectrum of Sample #1 contains peaks for Na⁺ (Figs 1, 4), Si⁺ (1, 5), K⁺ (1, 6), Ni⁺ (1, 9), Mg⁺ (4), Al⁺ (5), Mn⁺ (8) and polydimethylsiloxane (PDMS at m/z 73, 147, 207, 221, etc., Figs. 1, 2 and 3). There may be very low intensity Cr⁺ and Fe⁺ (possible interference by Si₂⁺) in Figures 7 and 8. PDMS is a commonly found surface contamination (see attachment). The sputter clean process may have reduced the PDMS amount in the analytical area.

Sample #2 contai⬛⬛ ⬛gs. 1, 4), Si⁺ (1, 5), K⁺ (1, 6), ⬛⬛⬛), Mg⁺ (4) and Al⁺ (5).
Low level Mn⁺ ion may be present (8).

Sample #3 shows peaks for Na⁺ (Figs. 1, 4), Si⁺ (5), K⁺ (1, 6), Ni⁻ (1, 9), Mg⁺ (4), Al⁺ (1, 5), Pb⁺ (3), Ca⁻ (6), Mn⁺ (8) Cr⁻ (1, 7) and Fe⁺ (1, 8).

Sample #4 contains Na⁺ (Figs. 1, 4), Si⁺ (5), K⁺ (1, 6), Ni⁺ (1, 9), Mg⁻ (4), Al⁺ (5), Cr⁻ (7) and Fe⁺ (8).

Regarding the H detection from the four samples, ion intensities for NiH⁺ and H⁺ are normalized to Ni⁺ and listed in Table 1.

In summary, various elemental ion species were found in the near surface analyses of the four samples. A few ion images acquired from Samples #1, #2 and #4 are included in Images 1 to 3 respectively. It appears that the ion distributions are not uniform in the 18 μm by 18 μm analytical fields. The non-uniformity in distributions are clearly shown in the ion images of Ni⁺ and K⁺ which are the most dominant ions.

This analysis required 4 hours of instrument time at $375.00 per hour. The total charge of $1,500.00 will be invoiced against your purchase order. Please send us a purchase order number if you have done so. If any questions arise about these data, please feel free to contact me.

Table 1. Relative intensities of NiH⁺ and H⁺ (normalized to Ni⁻).

Samples	Ni⁻ ion counts	H⁺	NiH⁺
#1	50230	8.2%	6.4%
#2	3331	20%	2.1%
#3	344508	3.7%	2.7%
#4	83481	4.6%	5 5%

#1P1

147 PDMS

117   133   191

#2P1

#3P1

Ni~
116
113 118
102   127 133

#4P1

113
117
104   126
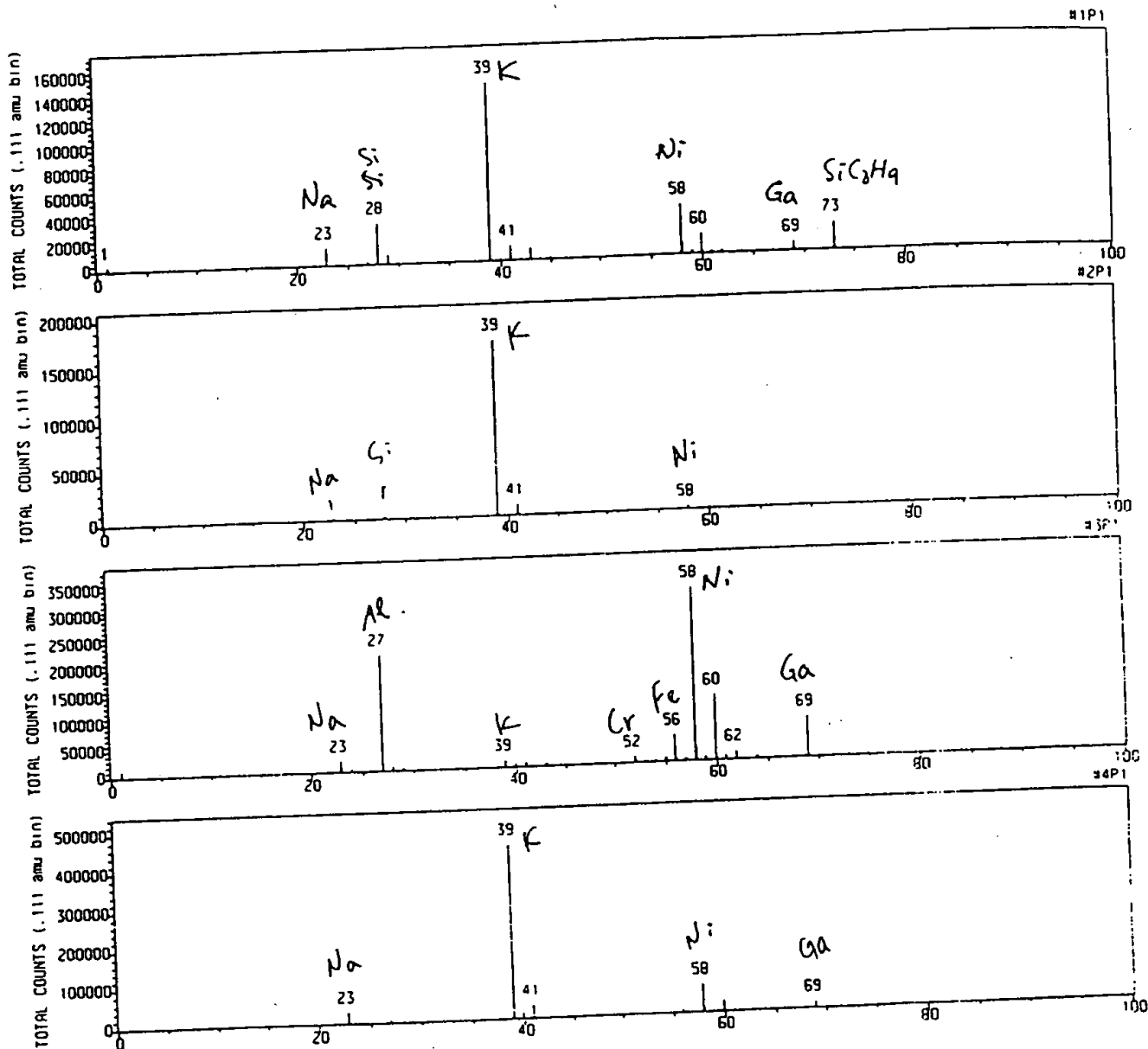
FILE NAME: #1P1   DATE · 15 Mar 94 13·21   ACQUISITION TIME: 21.2 MIN.   TOTAL INTEGRAL   454864

+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL
DATA SET: 1 Spectra; 3 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold

FILE NAME: #2P1   DATE : 15 Mar 94 14: 6   ACQUISITION TIME: 15.0 MIN.   TOTAL INTEGRAL   230391

+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL :5
DATA SET: 1 Spectra; 3 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold

FILE NAME: #3P1   DATE : 15 Mar 94 10:15   ACQUISITION TIME: 15.1 MIN.   TOTAL INTEGRAL : 1240561
EG&G/JACOX, #3;
+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL 15
DATA SET: 1 Spectra; 2 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold

FILE NAME: #4P1   DATE : 15 Mar 94 10:50   ACQUISITION TIME: 14.8 MIN.   TOTAL INTEGRAL : 824811
EG&G/JACOX, #3;
+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL: 15
DATA SET: 1 Spectra; 6 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold

FIGURE

FILE NAME: #1P1   DATE : 15 Mar 94 13:21   ACQUISITION TIME: 21.2 MIN.   TOTAL INTEGRAL : 464864

+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL 15~
DATA SET: 1 Spectra; 3 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold

FILE NAME: #2P1   DATE : 15 Mar 94 14: 6   ACQUISITION TIME: 15.0 MIN.   TOTAL INTEGRAL 210893

+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL 15~
DATA SET: 1 Spectra; 3 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold

FILE NAME: #3P1   DATE : 15 Mar 94 10:15   ACQUISITION TIME: 15.1 MIN.   TOTAL INTEGRAL : 1240561
EG&G/JACOX, #3:
+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL 15~
DATA SET: 1 Spectra; 2 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold

FILE NAME: #4P1   DATE : 15 Mar 94 10:50   ACQUISITION TIME: 14.8 MIN.   TOTAL INTEGRAL : 824811
EG&G/JACOX, #3:
+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL: 156
DATA SET: 1 Spectra; 6 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold   FIGURE 3

#1P1

Na 22.99

Mg 23.98

#2P1

22.99

23.99

#3P1

22.99

23.99

#4P1

22.99

23.99

FILE NAME #1P1   DATE : 15 Mar 94 13:21   ACQUISITION TIME. 21.2 MIN.   TOTAL INTEGRAL : 464864

+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL. 154
DATA SET· 1 Spectra; 3 Image(s)   RASTER SIZE· 31um   RASTER TYPE: Full I 4-Fold

FILE NAME #2P1   DATE : 15 Mar 94 14: 6   ACQUISITION TIME: 15.0 MIN.   TOTAL INTEGRAL : 230893

+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL: 156
DATA SET: 1 Spectra; 3 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold

FILE NAME: #3P1   DATE : 15 Mar 94 10:15   ACQUISITION TIME: 15.1 MIN.   TOTAL INTEGRAL : 1240561
EG&G/JACOX, #3;
+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL. 154
DATA SET: 1 Spectra; 2 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold

FILE NAME: #4P1   DATE : 15 Mar 94 10:50   ACQUISITION TIME: 14.8 MIN.   TOTAL INTEGRAL : 824811
EG&G/JACOX, #3;
+ IONS   PRIMARY GUN: Cesium   TIME RECORDER: 1-Stop TDC   X-Y SOURCE: Raster   TIME PER CHANNEL: 15
DATA SET: 1 Spectra; 6 Image(s)   RASTER SIZE: 31μm   RASTER TYPE: Full I 4-Fold

FIGURE __

FIGURE 6

FILE NAME: #1P1 DATE · 15 Mar 94 13:21 ACQUISITION TIME: 21.2 MIN. TOTAL INTEGRAL 164854

+ IONS PRIMARY GUN Cesium TIME RECORDER: 1-Stop TDC X-Y SOURCE: Raster TIME PER CHANNEL 156
DATA SET: 1 Spectra; 3 Image(s) RASTER SIZE: 31μm RASTER TYPE: Full I 4-Fold

FILE NAME: #2P1 DATE · 15 Mar 94 14· 6 ACQUISITION TIME: 15.0 MIN. TOTAL INTEGRAL 230873

+ IONS PRIMARY GUN: Cesium TIME RECORDER: 1-Stop TDC X-Y SOURCE: Raster TIME PER CHANNEL 156
DATA SET: 1 Spectra; 3 Image(s) RASTER SIZE: 31μm RASTER TYPE: Full I 4-Fold

FILE NAME: #3P1 DATE : 15 Mar 94 10:15 ACQUISITION TIME: 15.1 MIN. TOTAL INTEGRAL : 1240561
EG&G/JACOX, #3:
+ IONS PRIMARY GUN: Cesium TIME RECORDER: 1-Stop TDC X-Y SOURCE. Raster TIME PER CHANNEL 156
DATA SET· 1 Spectra; 2 Image(s) RASTER SIZE: 31μm RASTER TYPE: Full I 4-Fold

FILE NAME: #4P1 DATE : 15 Mar 94 10:50 ACQUISITION TIME: 14.8 MIN. TOTAL INTEGRAL : 824811
EG&G/JACOX, #3:
+ IONS PRIMARY GUN: Cesium TIME RECORDER: 1-Stop TDC X-Y SOURCE: Raster TIME PER CHANNEL· 15·
DATA SET: 1 Spectra; 6 Image(s) RASTER SIZE: 31μm RASTER TYPE: Full I 4-Fold

FIGURE 1

CHARLES EVANS & ASSOCIATES
301 Chesapeake Drive
Redwood City, CA 94063 USA
Phone: (415) 369-4567; FAX: (415) 369-7921

File Name:
TOF IM708
Mass:
Lo: 0.0000
Hi: 1000.0000
Status:
Saved On Disk
Spectrum:
#1P1
Image Scale:

5 μm

Comments: TOTAL + IONS, #1
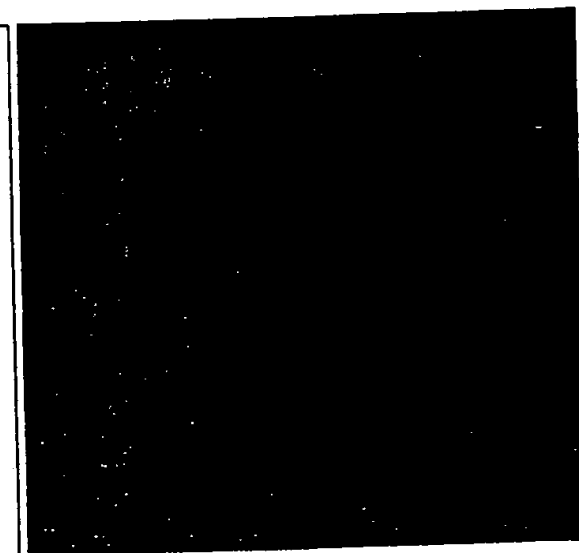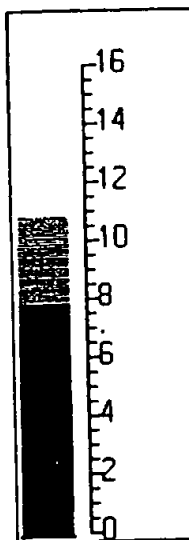
File Name:
TOFIM709
Mass:
Lo: 57.7334
Hi: 58.1468
Status:
Saved On Disk
Spectrum:
#1P1
Image Scale:

5 μm

Comments: Ni+ IONS, #1
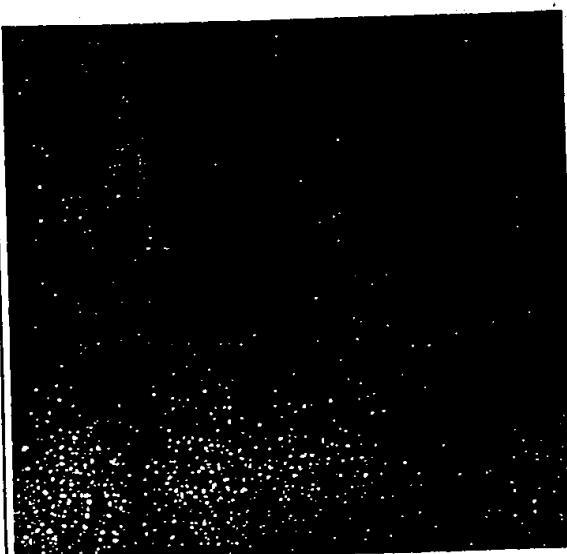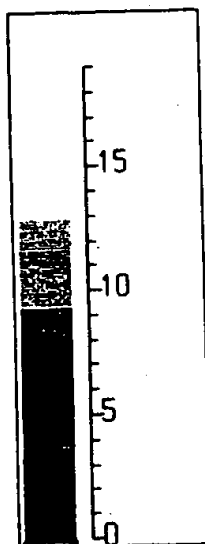
File Name:
TOFIM710
Mass:
Lo: 38.7570
Hi: 39.1704
Status:
Saved On Disk
Spectrum:
#1P1
Image Scale:

5 μm

Comments: K+ IONS, #1

Image 1

FIGURE _____

Comments: TOTAL + IONS, #2
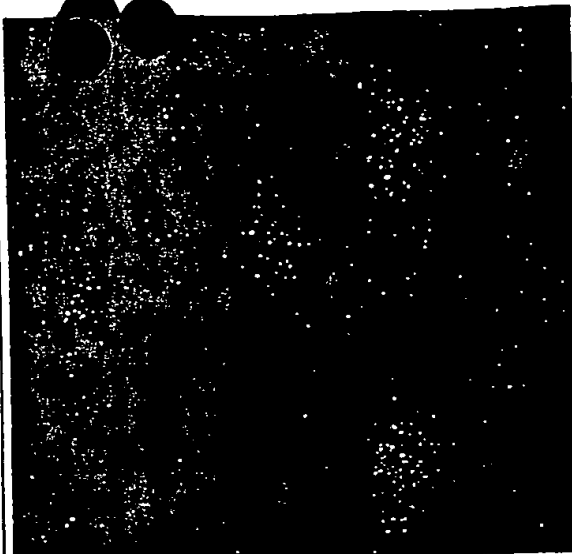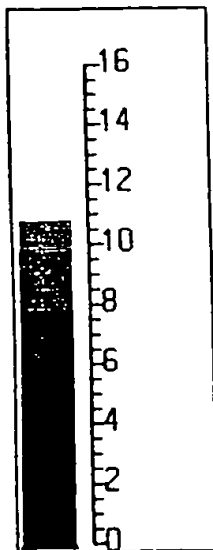
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Mass:
Lo: 0.0000
Hi: 1000.0000
Status:
Saved On Disk
Spectrum:
#2P1
Image Scale:
5 μm
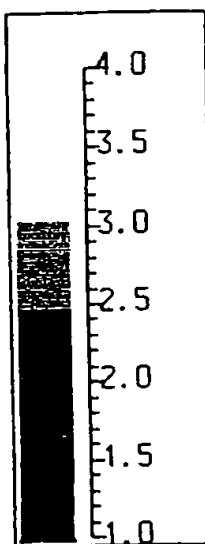
Comments: Ni+ IONS, #2

File Name:
TOFIM766
Mass:
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Hi: 58.1468
Status:
Saved On Disk
Spectrum:
#2P1
Image Scale:
5 μm
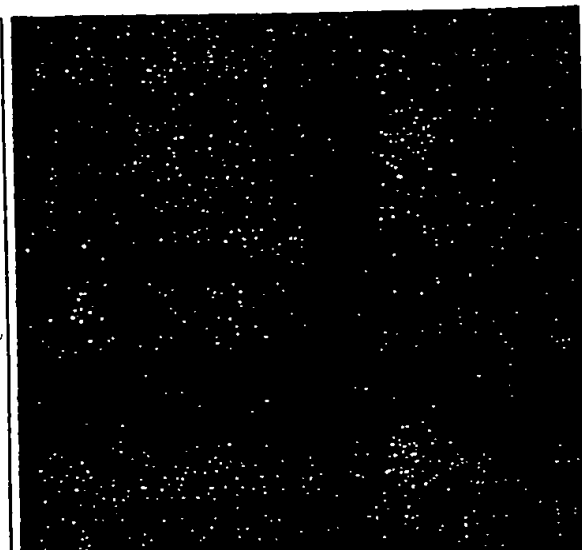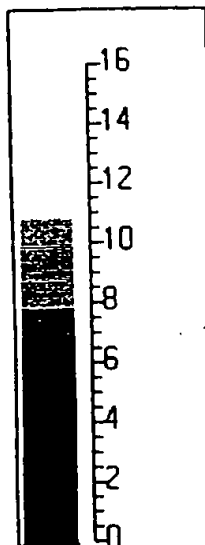
Comments: K+ IONS, #2

File Name:
TOFIM767
Mass:
Lo: 38.7570
Hi: 39.1704
Status:
Saved On Disk
Spectrum:
#2P1
Image Scale:
5 μm

Image 1

FIGURE _____
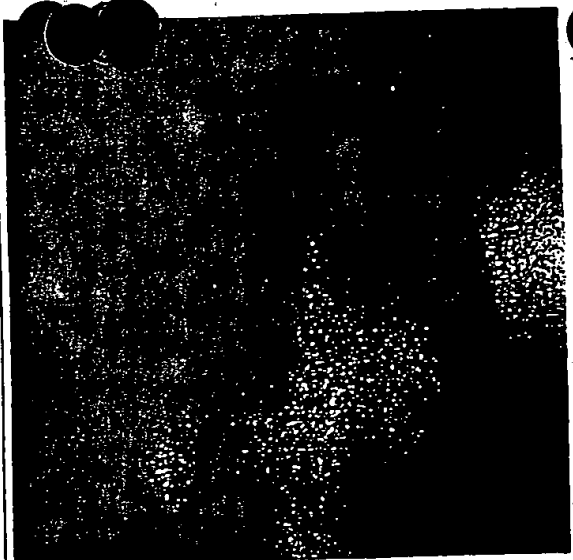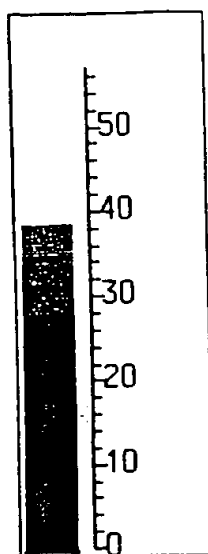
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Lo: 0.0000
Hi: 400.0000
Status:
Saved On Disk
Spectrum:
#4P1
Image Scale:

5 μm

Comments: TOTAL + IONS, #4
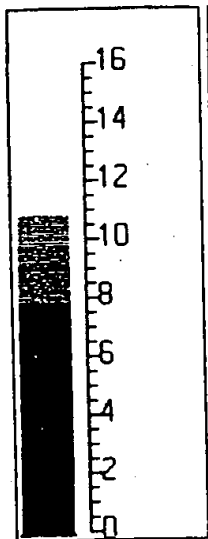
File Name:
TOFIM637
Mass:
Lo: 57.7308
Hi: 58.2193
Status:
Saved On Disk
Spectrum:
#4P1
Image Scale:

5 μm

Comments: Ni+ IONS, #4
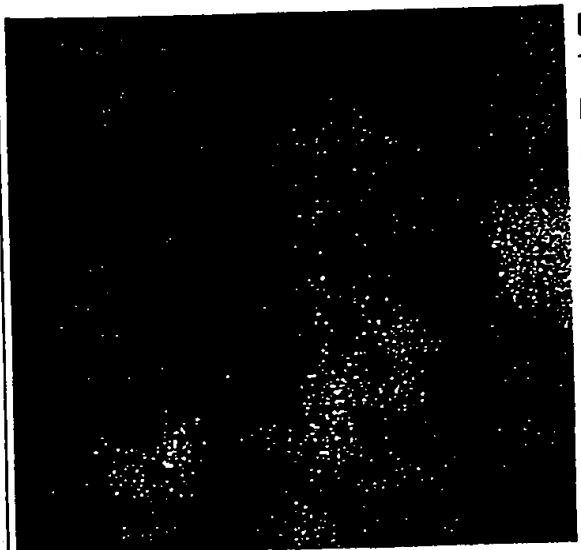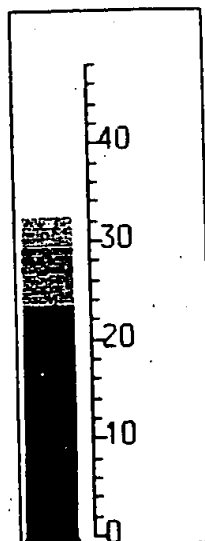
File Name:
TOFIM638
Mass:
Lo: 38.9553
Hi: 38.9730
Status:
Saved On Disk
Spectrum:
#4P1
Image Scale:

5 μm

Comments: K+ IONS, #4

Image 3

FIGURE _____ __

Comments: Na+ IONS,#4
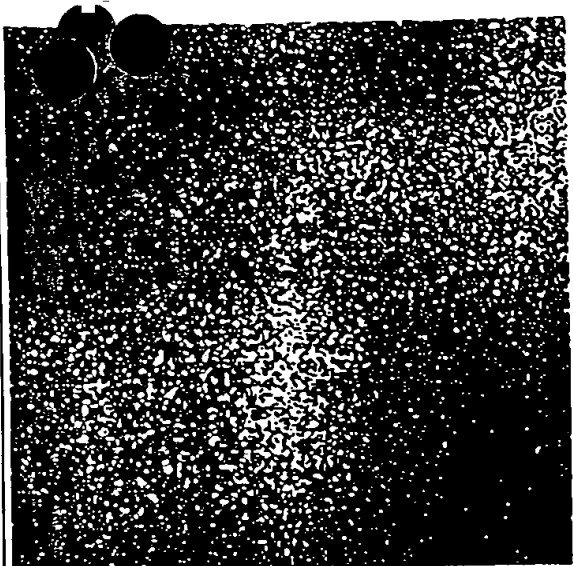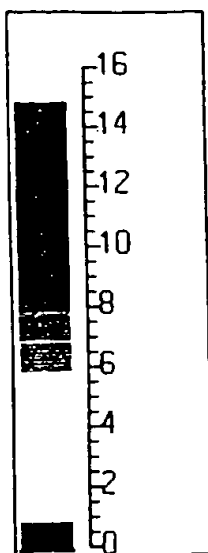
File Name:
TOFIM640
Mass:
Lo: 22.9581
Hi: 23.0214
Status:
Saved On Disk
Spectrum:
#4P1
Image Scale:

5 µm
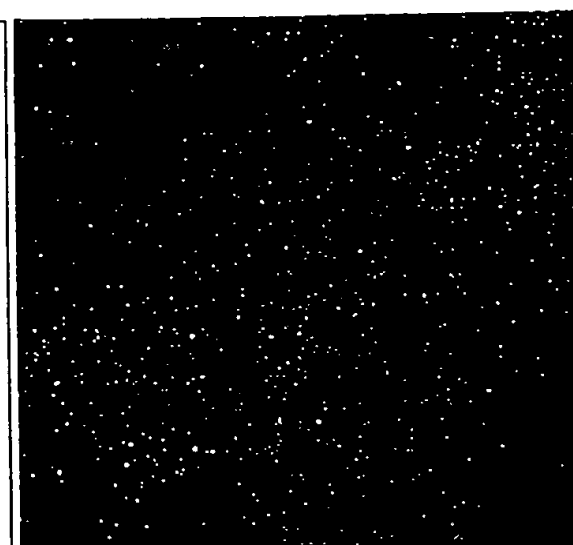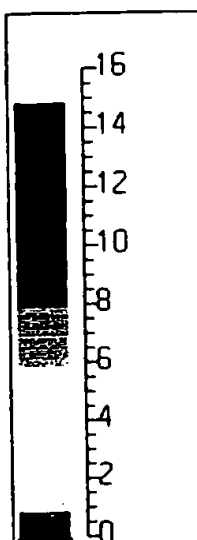
Comments: Mg+ IONS,#4

File Name:
TOFIM641
Mass:
Lo: 23.9534
Hi: 24.0166
Status:
Saved On Disk
Spectrum:
#4P1
Image Scale:

5 µm

Image 3

FIGURE _____

Figure 34

Sample #14 (Na)

Sample #9 (K)

K

Mg

X

Binding Energy [eV]

Counts x10³
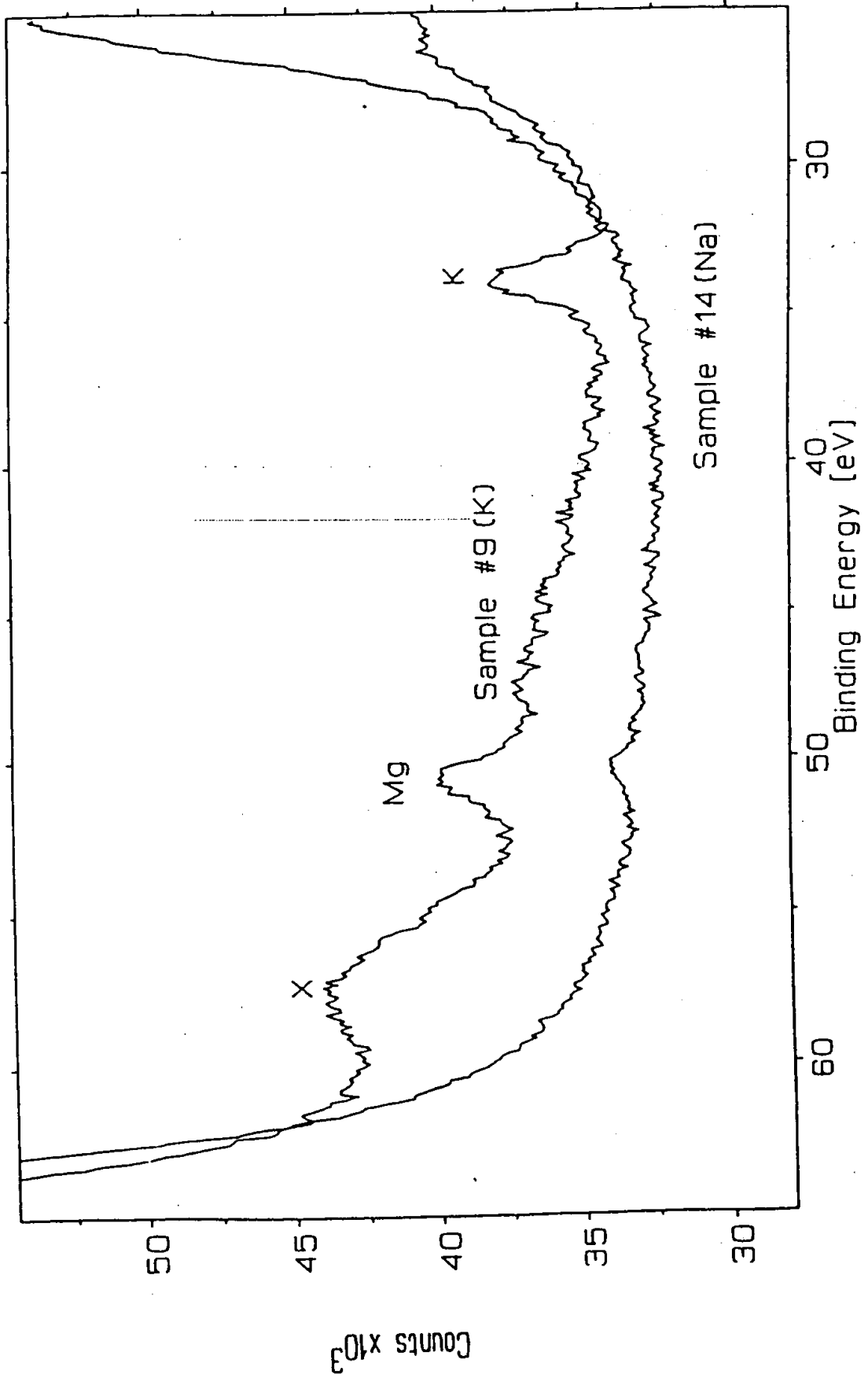
HPCK-09.003

ESCA SURVEY 11/18/93 ANGLE= 15 deg ACQ TIME=29.36 min

FILE: Nitest21 Ni wire processed in lab. as received.

SCALE FACTOR= 12.496 k c/s, OFFSET= 1.542 k c/s PASS ENERGY=178.950 eV Al 400 W

BINDING ENERGY, eV

N(E)/E, sat

ESCA MULTIPLEX 11/18/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=67.28 min
FILE: Nitest20 Ni wire processed in lab. as received.
SCALE FACTOR= 0.301 k c/s, OFFSET= 2.742 k c/s PASS ENERGY=143.050 eV Al 400 W

N(E)/E

BINDING ENERGY, eV

ESCA MULTIPLEX 11/24/93 EL= REG 2 ANGLE= 15 deg ACQ TIME=114.08 min

FILE: Nitest50 Ni wire treated overnight at IRC.

SCALE FACTOR= 0.095 k c/s, OFFSET= 1.036 k c/s PASS ENERGY=143.050 eV Al 400 W

N(E)/E,sat

BINDING ENERGY, eV

F-4
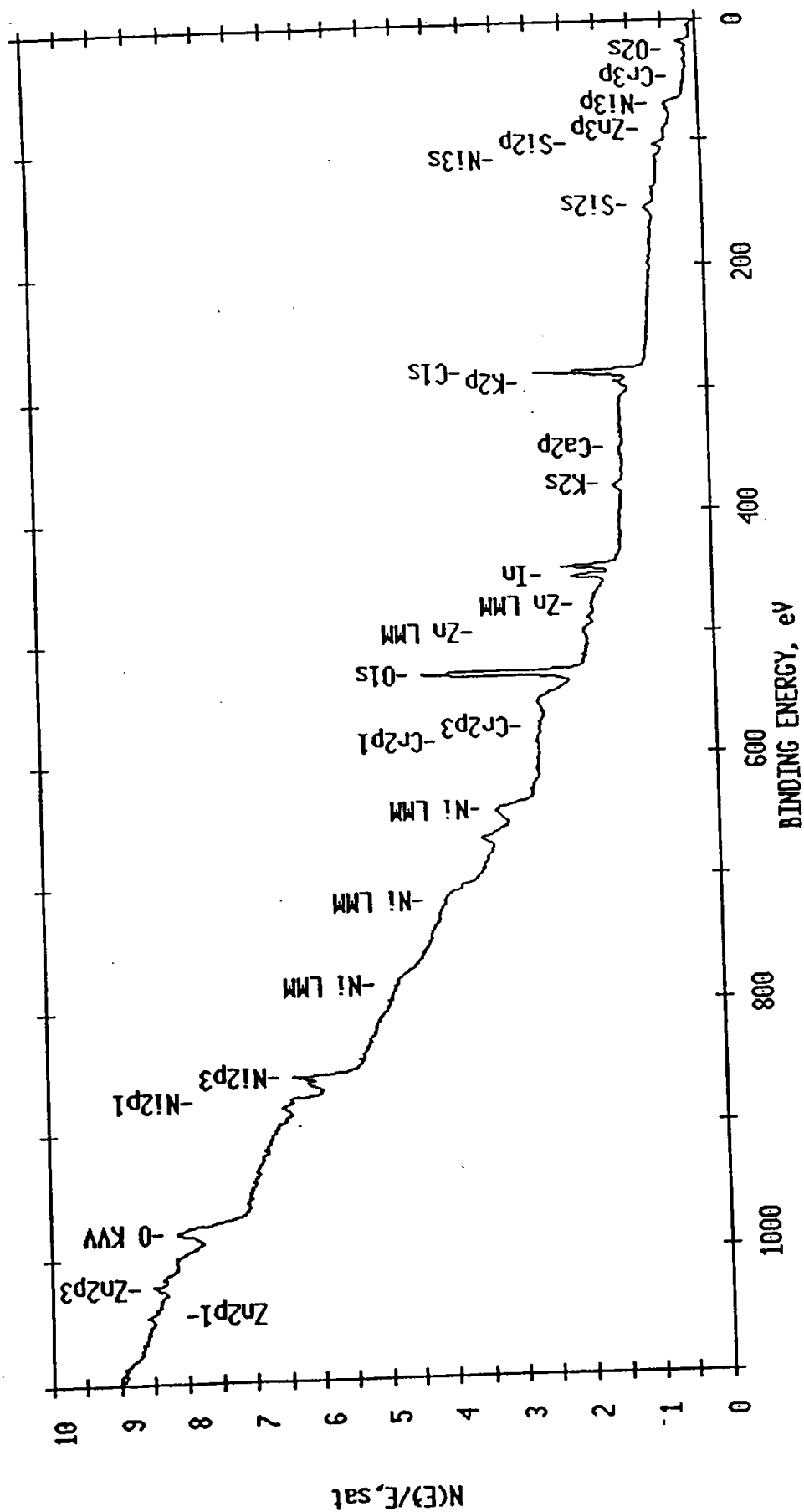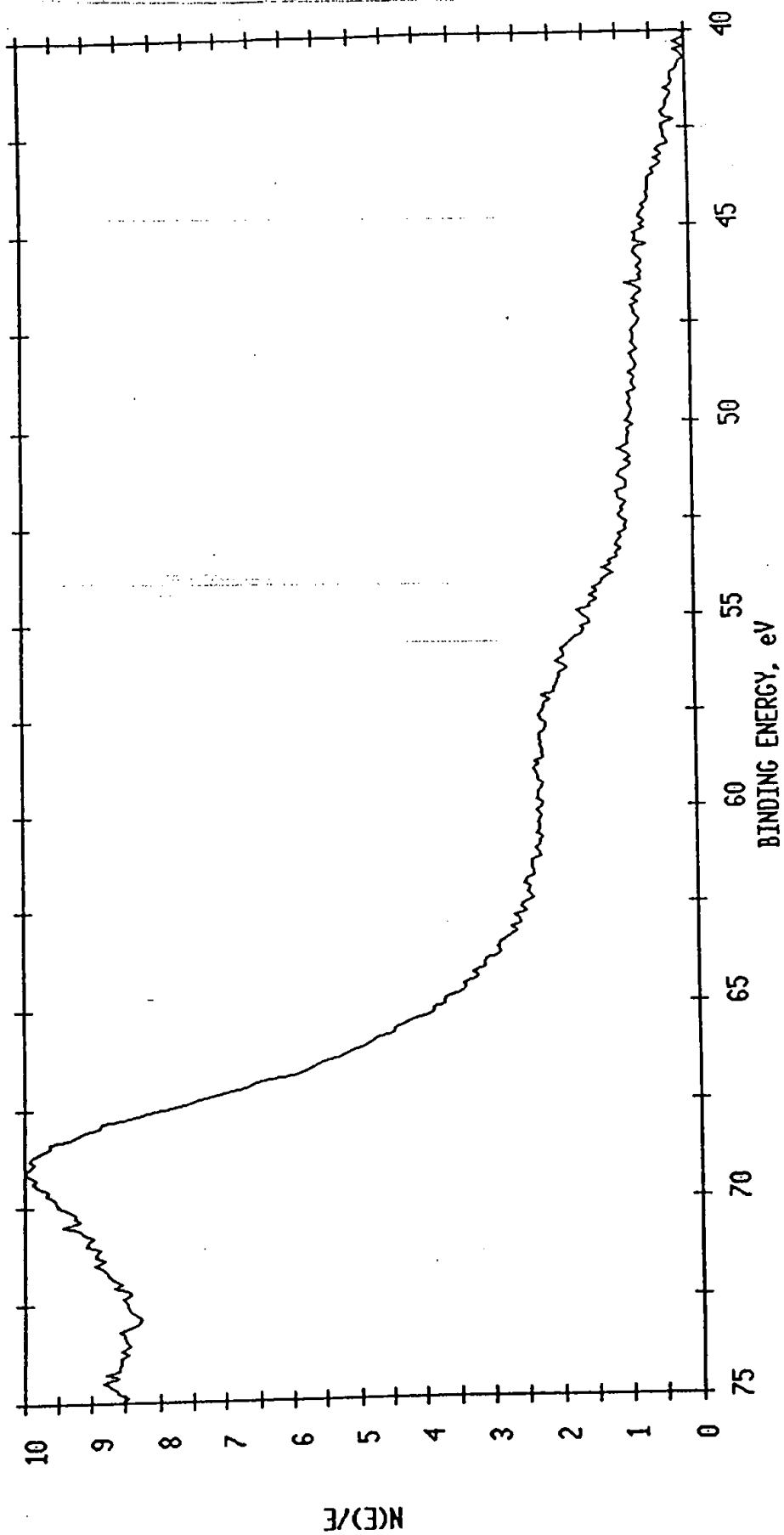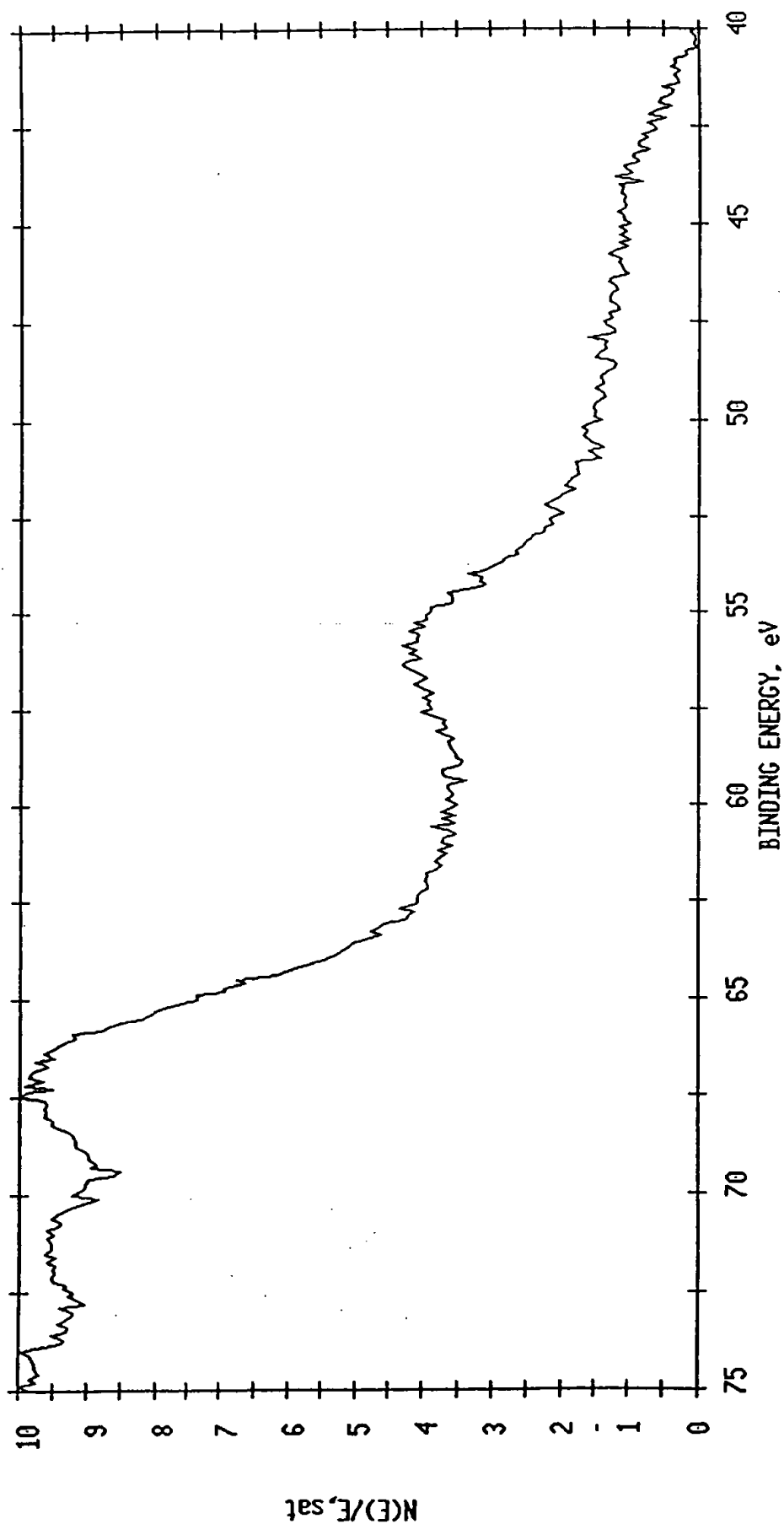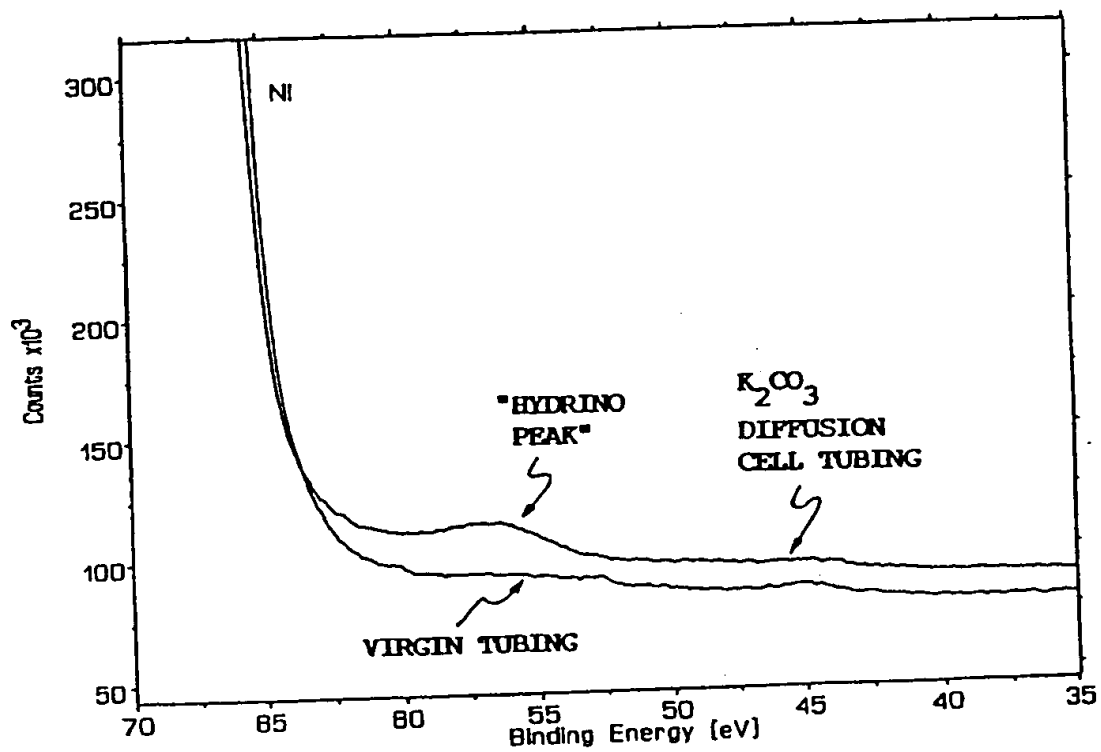
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Craig, A., Y., Charles Evans & Associates XPS/ESCA Results, CE&A Number 44545, November 3, 1994

CHARLES EVANS & ASSOCIATES

SPECIALISTS IN MATERIALS CHARACTERIZATION

FACSIMILE COMMUNICATION•FACSIMILE COMMUNICATION•FACSIMILE COMMUNICATION

COMPANY: Hydrocatalysis Power

ATTENTION: Stev Bollinger

DESTINATION
FAX NO: (610) 651-4940

FROM: Dr. A.Y. Craig

SUBJECT: XPS/ESCA Results (CEA #44545)

REF NO: G9942

DATE: November 3, 1994

PAGE 1 OF 7

CE&A REPLY FAX
NO: (415) 369-7921

Please find attached typical results for your samples. A 2 mm x 0.8 mm analysis area was selected for this work.

Elements C, O, N, Si, Cl, S, Ni, Zn, Sn, K, Ca, Mg and Cr are detected at the surface for the Nickel Cathode Sample #A. The concentration for C is approximately 52 at%, while that for Ni is approximately 9 at%. The concentrations for Ca (approximately 0.1 at%) and Mg (approximately 0.2 at%) are considered maximum values due to the noisy spectra.

Elements C, O, N, Si, S, Ni, Zn, Sn, Mg and Cr are detected at the surface for the Nickel Cathode Sample #B. The concentration for C is approximately 41 at%, while that for Ni is approximately 13 at%.

This analysis involved approximately 8 hours of instrument time. You will be invoiced for 6 hours ($1800.00), as quoted. If you have any questions regarding this work, please call me.

Sincerely,

Angela Y. Craig

ESCA Survey 1 Nov 94   Angle: 45 degrees Acquisition Time: 29.82 min

File: HYDROCAT10 SAMPLE A

Scale Factor: 29.950 kc/s   Offset: 7.175 kc/s   Pass Energy: 187.850 eV Aperture: 5 Al 450 W

②

N(E)/E

Binding Energy (eV)

O1s

C1s

N1s

S2s

Ni Lmm

CuP

KVV

N1s KVVL

Si2s

Cu2p

S2p

N(3s) Ni3p

S4

Ni 2p

Okvw

Zn2p

CuLL

Mg1s

Sample A

C: 52.2 at%   Zn: 0.4
O: 31.8   Sn: 0.1
N: 1.0   K: 1.6
S: 1.3   Ca: 0.1
Cl: 0.8   Mg: 0.2
Si: 1.2   Cu: 0.4
Ni: 8.9

(3)

ESCA Multiplex 1 Nov 94   Species: C1 Region: 1 Angle: 45 degrees Acquisition Time: 2.09 min
File: HYDROCAT11 SAMPLE A
Scale Factor: 6.336 kc/s   Offset: 13.449 kc/s Pass Energy: 58.700 eV Aperture: 5 Al 450 W
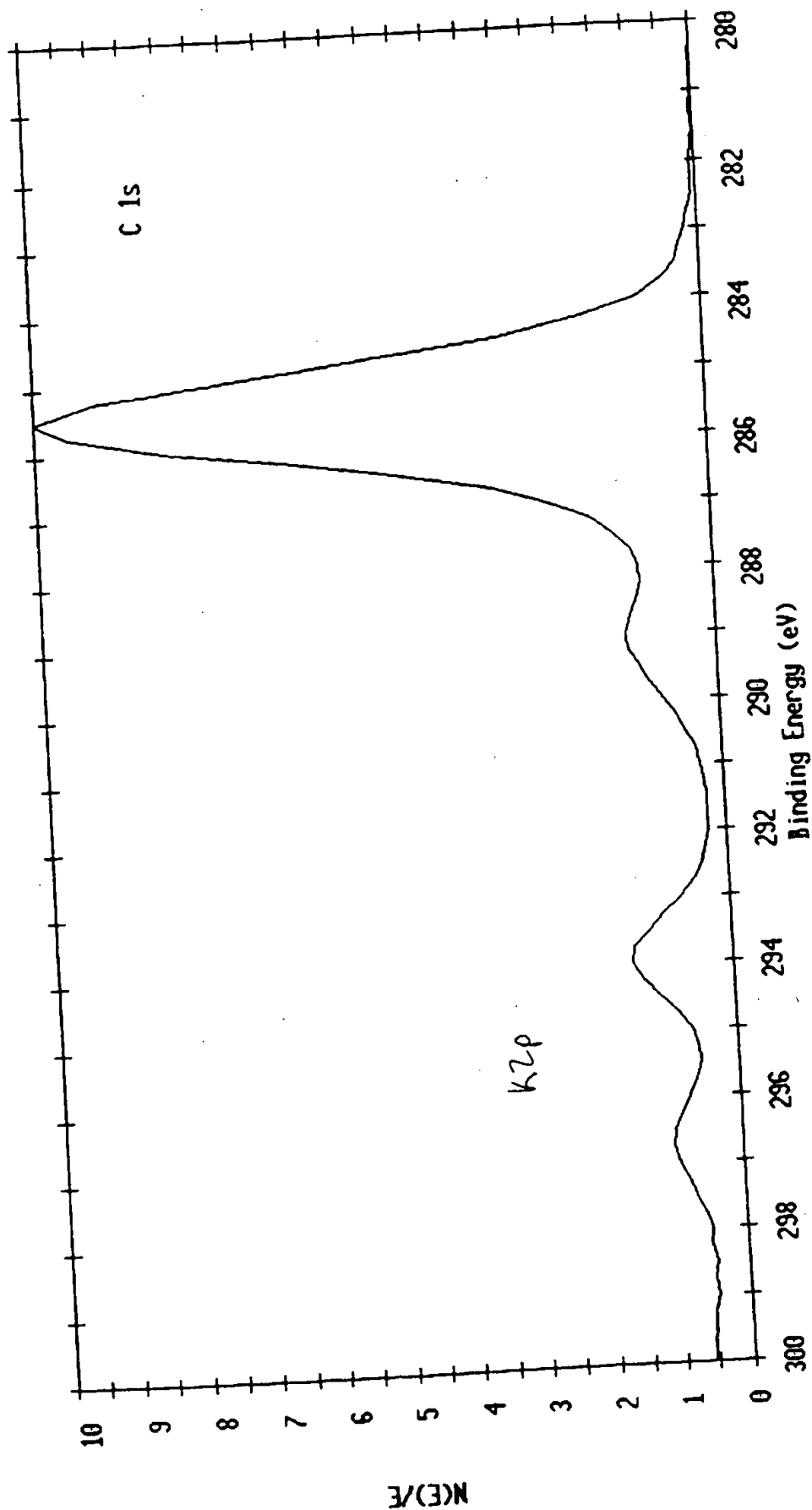
C 1s

K2p

Binding Energy (eV)

N(E)/E

ESCA Multiplex 1 Nov 94   Species: Fe3   Region: 2   Angle: 45 degrees Acquisition Time: 116.46 min

File: HYDROCAT11 SAMPLE A

Scale Factor: 1.290 kc/s   Offset: 3.150 kc/s   Pass Energy: 58.700 eV Aperture: 5 Al 450 W

Binding Energy (eV)

N(E)/E

⑤
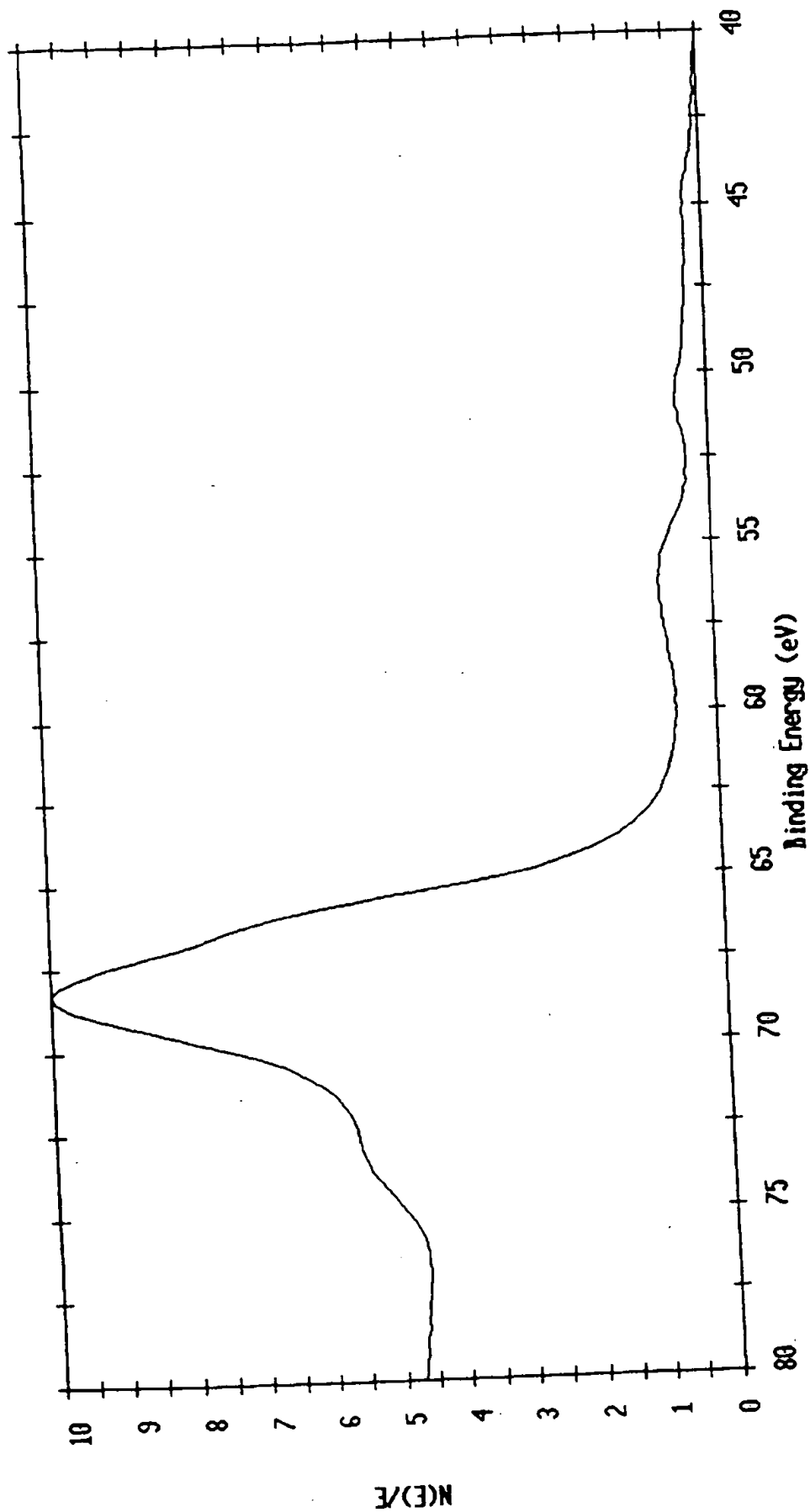
ESCA Survey 1 Nov 94 Angle: 45 degrees Acquisition Time: 29.82 min
File: HYDROCAT20 SAMPLE B
Scale Factor: 30.190 kc/s   Offset: 6.971 kc/s Pass Energy: 187.850 eV Aperture: 5 Al 450 W
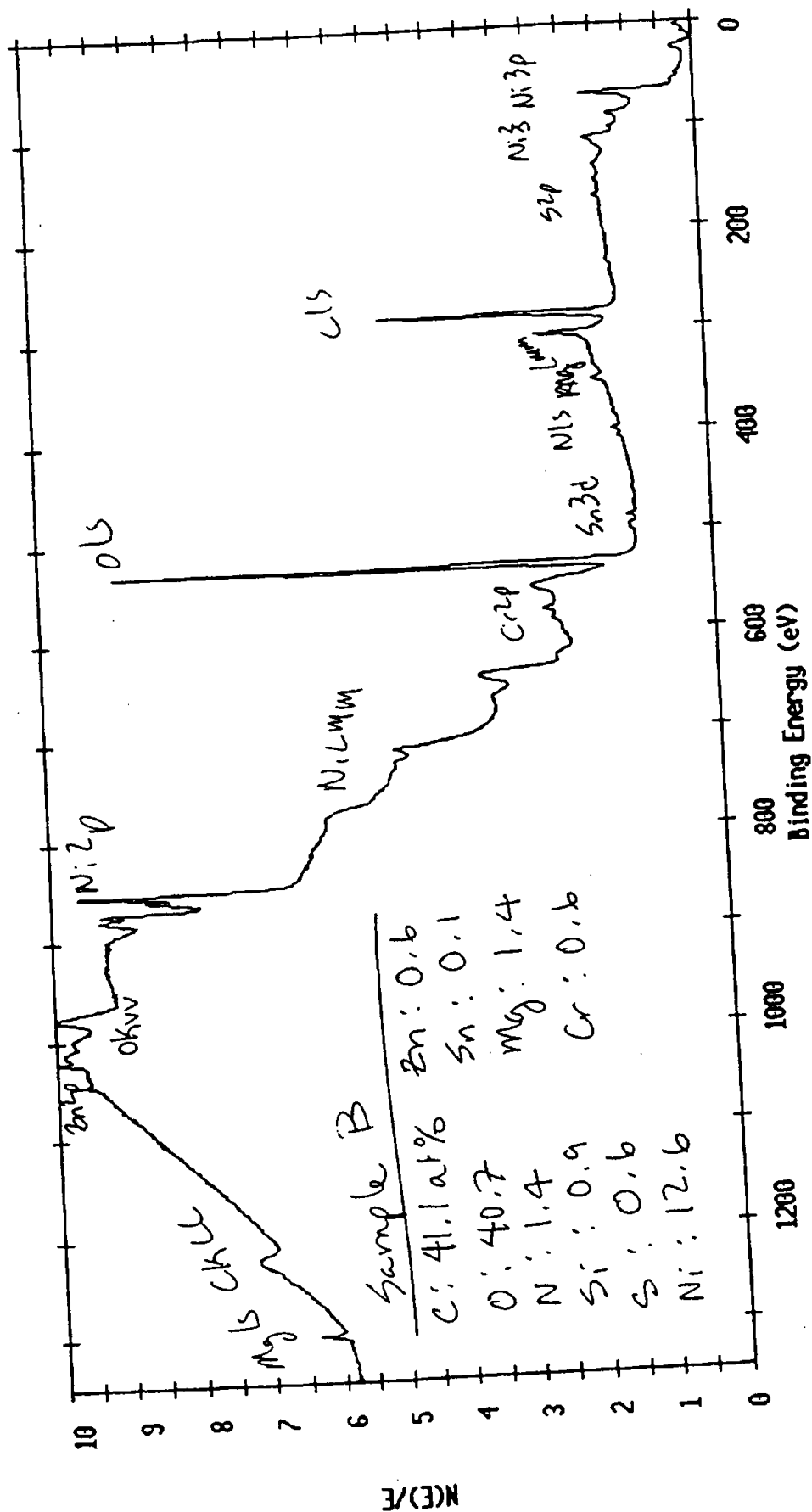
Sample B
C: 41.1 at%   Zn : 0.6
O: 40.7   Sn : 0.1
N : 1.4   Mo : 1.4
Si : 0.9   Cr : 0.6
S : 0.6
Ni : 12.6

(b)

ESCA Multiplex 1 Nov 94 Species: C1 Region: 1 Angle: 45 degrees Acquisition Time: 2.09 min

File: HYDROCAT21 SAMPLE B

Scale Factor: 4.695 kc/s Offset: 12.191 kc/s Pass Energy: 58.700 eV Aperture: 5 Al 450 W
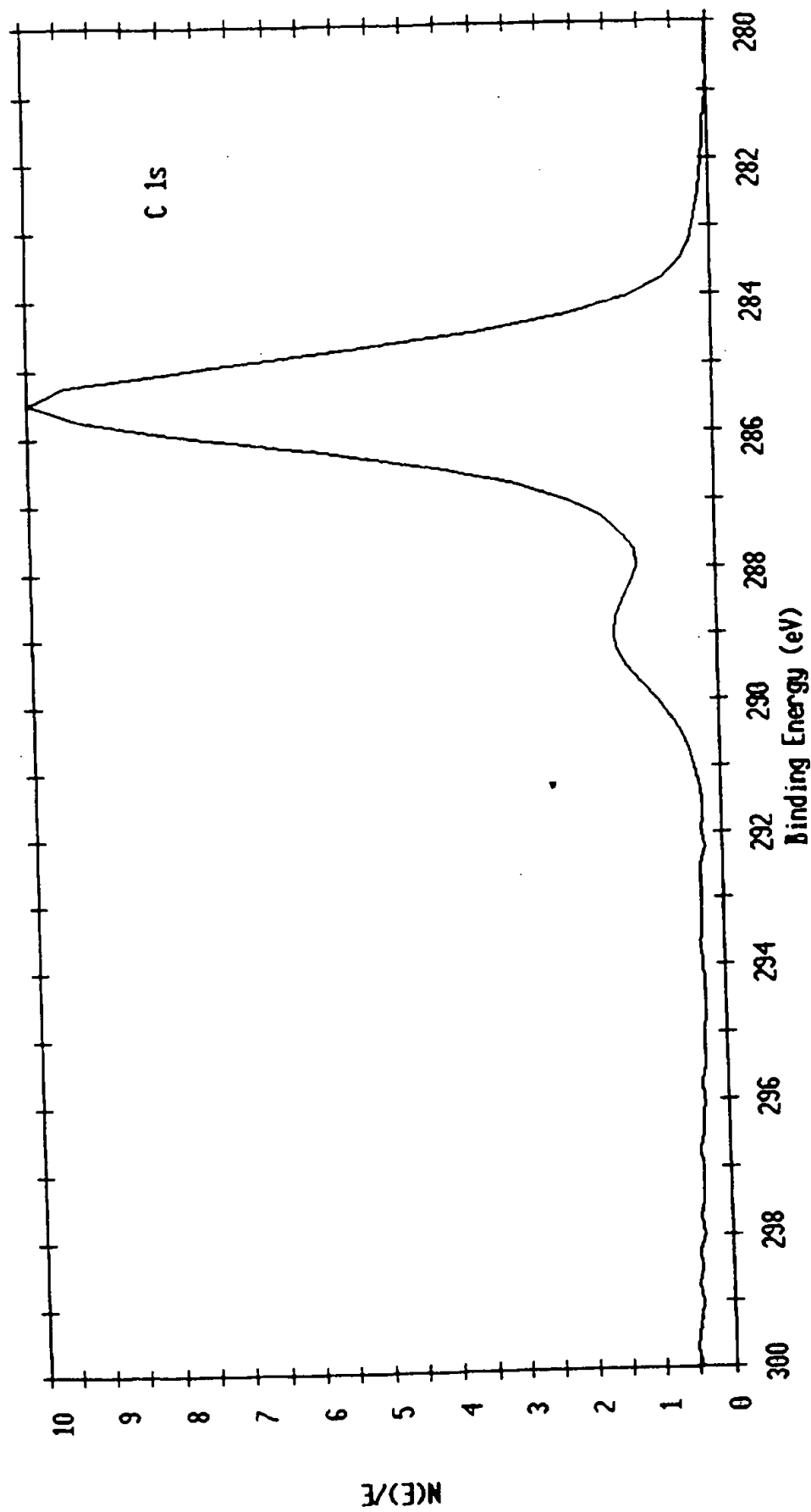
C 1s

N(E)/E

Binding Energy (eV)

ESCA Multiplex 1 Nov 94   Species: Fe3   Region: 2 Angle: 45 degrees Acquisition Time: 116.46 min
File: HYDROCAT21 SAMPLE B
Scale Factor: 1.536 kc/s   Offset: 2.987 kc/s   Pass Energy: 58.700 eV Aperture: 5 Al 450 W
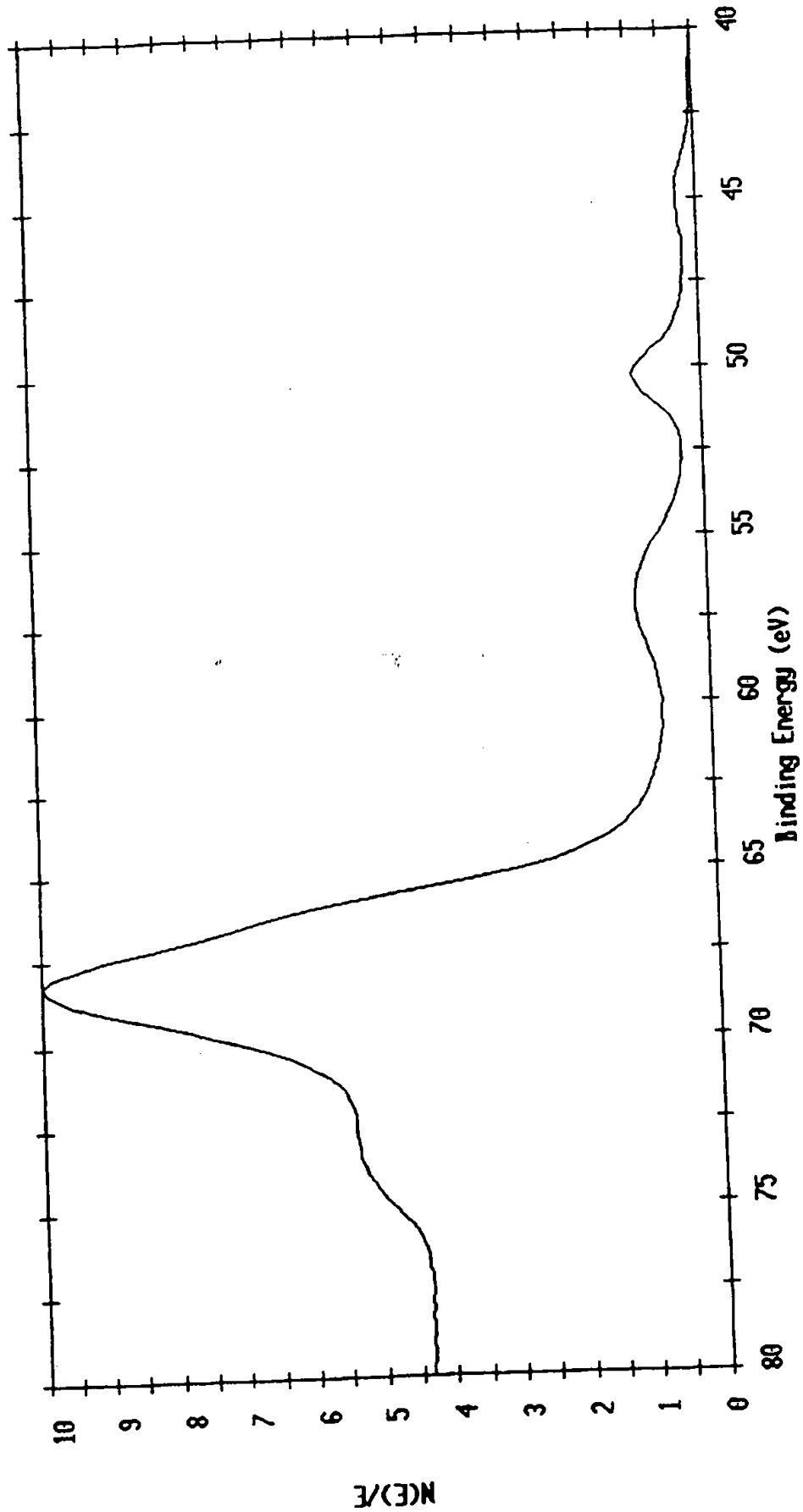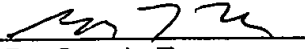
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DECLARATION OF DR. GARY L. TURNER

I, Gary L. Turner, declare and state that:

1. I received a Bachelor of Science degree in Chemistry from the University of Illinois, Urbana, Illinois in 1978 and a Doctorate degree in Physical Chemistry at the University of Arkansas, Fayetteville, Arkansas in 1982.

2. From July 1982 to June 1988, I was a research associate for Dr. E. Oldfield, at the University of Illinois, Urbana, Illinois.

3. From August 1985 to the present, I have been employed by Spectral Data Services, Inc., where my duties include conducting Nuclear-Magnetic-Resonance scans on sample materials.

4. From April 1986 to August 1990 I was also employed as the Vice-President of Probe Systems, Inc., where I was responsible for designing Nuclear-Magnetic-Resonance (NMR) equipment.

5. I have published 38 peer-reviewed scientific papers, a list of which is shown in the Attachment.

6. Over the last year, I conducted ^{1}H MAS NMR scans on about 100 blind samples of compounds provided by BlackLight Power, Inc.

7. A 270 MHz NMR Spectrometer, operating at a Larmor frequency of 270.6196 MHZ was used. The Spectrometer was equipped with a Tecmag operating system and Henry Radio amplifiers for pulse generation. The probe was a 7 mm Doty Scientific Standard Probe. The data was collected with a pulse angle of about 35°, with a two second delay between pulses. The samples were spun at two speeds, usually at 4.5 and 3.5 KHz, to identify the spinning sidebands. Typically, 200 transients were collected for each spectrum. The data was processed using NUT (Acorn NMR, Inc.) software.

8. Some of the samples showed signals in regions that are not typical. Most ^{1}H MAS NMR signals are observed from about 10 to 0 ppm, where ppm represents the shift from the control sample, tetramethylsilane. Signals were observed at -4 to -5 ppm. Since 1978, I have been primarily conducting NMR scans and I have never observed signals in the region of -4 to -5 ppm before.

9. I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

By _____
Dr. Gary L. Turner

Date: ___5/18/00___

ATTACHMENT

Published Papers of Dr. Gary L. Turner

1. G. L. Turner and E. Oldfield, "Effect of a local anaesthetic on hydrocarbon chain order in membranes," Nature 277, 669-70 (1979).

2. J. F. Hinton, G. L. Turner, and F. S. Millett, "A thallium-205 NMR investigation of the thallium(I)-gramicidin complex," J. Magn. Reson. 45, 42-47 (1981).

•3. G. L. Turner, J. F. Hinton, and F. S. Millett, "A thallium-205 NMR study of thallium acetate ion association in 2,2,2-trifluoroethanol and dimethylsulfoxide," J. Sol. Chem. 11, 379-86 (1982).

4. G. L. Turner, J. F. Hinton, and F. S. Millett, "Thallium-205 nuclear magnetic resonance study of the thallium(I)-gramicidin A association in trifluoroethanol," Biochem. 21, 646-51 (1982).

5. J. F. Hinton, G. L. Turner, G. Young, and K. R. Metz, "Thallium-205 NMR studies of the Tl(I) ion complexation by gramicidin in non-aqueous and micelle solutions," Pure & Appl. Chem. 54, 2359-68 (1982).

6. G. L. Turner, J. F. Hinton, and F. S. Millett, "A ^{205}Tl and ^{13}C NMR study of the Tl(I)-gramicidin A association in dimethylsulfoxide," J. Magn. Reson. 51, 205-12 (1983).

7. G. L. Turner, J. F. Hinton, R. E. Koeppe II, J. A. Parli, and F. S. Millett, "Difference in association of Tl(I) with gramicidin A and gramicidin B in trifluorethanol determined by Tl-205 NMR," Biochim. Biophys. Acta. 756, 133-37 (1983).

8. J. F. Hinton and G. L. Turner, "Tl-205 and C-13 NMR study of the Tl(I)-enniatin B complex," J. Magn. Reson. 59, 262-67 (1984).

9. R. J. Kirkpatrick, K. A. Smith, S. Schramm, G. Turner, and W. H. Yang, "Solid-state nuclear magnetic resonance spectroscopy of minerals," Ann. Rev. Earth Plant Sci. 13, 29-47 (1985).

10. J. F. Hinton, K. R. Metz, G. L. Turner, D. L. Bennett, and F. S. Millett, "Solid-state thallium-205 NMR study of the gramicidin and lasalocid Tl(I) complexes," J. Magn. Reson. 64, 120-123 (1985).

11. G. L. Turner, S. E. Chung, and E. Oldfield, "Solid-state oxygen-17 nuclear magnetic resonance spectroscopic study of the group II oxides," <u>J. Magn. Reson. 64</u>, 316-324 (1985).

12. R. J. Kirkpatrick, T. Dunn, S. Schramm, K. A. Smith, R. Oestrike, and G. Turner, "Magic-angle sample-spinning nuclear magnetic resonance spectroscopy of silicate glasses: a review," in <u>Structure and Bonding in Non-Crystalline Solids</u>, eds., G. E. Walrafen and A. G. Revesz, 303-327 (1986).

13. G. L. Turner, K. A. Smith, R. J. Kirkpatrick, and E. Oldfield, "Boron-11 nuclear magnetic resonance spectroscopic study of borate and borosilicate minerals, and a borosilicate glass," <u>J. Magn. Reson. 67</u>, 544-550 (1986).

14. A. C. Kunwar, G. L. Turner, and E. Oldfield, "Solid-state spin-echo Fourier transform NMR of ^{39}K and ^{67}Zn salts at high-field, <u>J. Magn. Reson. 69</u>, 124-127 (1986).

15. H. K. C. Timken, G. L. Turner, J. P. Gilson, L. B. Welsh, and E. Oldfield, "Solid-state oxygen-17 nuclear magnetic resonance spectroscopic study of zeolites and related systems. I.," <u>J. Amer. Chem. Soc. 108</u>, 7321-7235 (1986).

16. H. K. C. Timken, N. Janes, G. L. Turner, S. L. Lambert, L. B. Welsh, and E. Oldfield, "Solid-state oxygen-17 nuclear magnetic resonance spectroscopic study of zeolites and related systems. II., <u>J. Amer. Chem. Soc. 108</u>, 7236-7241 (1986).

17. W. H. Yang, R. J. Kirkpatrick, and G. Turner, "^{31}P and ^{29}Si MASS NMR investigation of the structural environment of phosphorus alkaline-earth silicate glass," <u>J. Amer. Ceram. Soc. 69</u>, C222-C223 (1986).

18. C. T. G. Knight, G. L. Turner, and E. Oldfield, "Solid-state tungsten-183 nuclear magnetic resonance spectroscopy," <u>J. Amer. Chem. Soc. 108</u>, 7426-7427 (1986).

19. G. L. Turner, K. A. Smith, R. J. Kirkpatrick, and E. Oldfield, "Structure and cation effects on phosphorus-31 NMR chemical shifts and chemical-shift anisotropies of orthophosphates," <u>J. Magn. Reson. 70</u>, 408-415 (1986).

20. G. L. Turner, R. J. Kirkpatrick, S. Risbud, and E. Oldfield, "Multi-nuclear magic-angle sample spinning nuclear magnetic resonance spectroscopic studies of crystalline and amorphous ceramic materials," <u>J. Amer. Ceram. Soc. 66</u>, 656-663 (1987).

21. R. Oe⬤ke, A. Navrotsky, G. L. ⬤er, B. Montez, and R. J. Kirkpatrick, "The structura⬤tate of aluminum at low concentrations in $2PbO.B_2O_3$ glasses used for solution calorimetry: An aluminum-27 NMR study," <u>Amer. Mineral. 72</u>, 788-791 (1987).

22. B. C. Bunker, D. R. Tallant, C. A. Balfe, R. J. Kirkpatrick, G. L. Turner, and M. R. Reidmeyer, "Structure of phosphorus oxynitride glasses," <u>J. Amer. Ceram. Soc. 70</u>, 675-81 (1987).

23. T. H. Walter, G. L. Turner, and E. Oldfield, "Oxygen-17 cross-polarization nuclear magnetic resonance spectroscopy of inorganic solids," <u>J. Magn. Reson. 76</u>, 106-120 (1988).

24. J. Lipowitz and G. L. Turner, "^{29}Si and ^{13}C magic angle sample spinning nuclear magnetic resonance spectroscopy of amorphous ceramic fibers prepared by prolysis of organosilicon polymers," <u>Polymer Preprints 29</u>, 74-77 (1988).

25. R. C. Bunker, D. R. Tallant, T. J. Hendley, G. L. Turner, and R. J. Kirkpatrick, "The structure of leached sodium borosilicate glass," <u>Phys. Chem. Glass, 29</u>, 106-120 (1988).

26. B. C. Bunker, C. H. F. Peden, D. R. Tallant, S. L. Martinez, and G. L. Turner, "Raman and NMR studies of hydrous sodium titanates," <u>Mat. Res. Soc. Symp. Proc. 121</u>, 105-109 (1988).

27. K. L. Geisinger, R. Oestrike, A. Navrotsky, G. L. Turner, and R. J. Kirkpatrick, "Thermochemistry and structure of glasses along the join $NaAlSi_3O_8$, $NaBSi_3O_8$," <u>Geochim. Cosmochi. Acta. 52</u>, 2405-2414 (1988).

28. B. C. Bunker, D. R. Tallant, R. J. Kirkpatrick, and G. L. Turner, "Multinuclear nuclear magnetic resonance and Raman investigation of sodium borosilicate glass structures," <u>Phys. Chem. Glasses 31</u>, 30-41 (1990).

29. R. K. Brow, R. J. Kirkpatrick, and G. L. Turner, "Local structure of $XAl_2O_3.(1-x)NaPO^3$ glasses: an NMR and xps study", <u>J. Amer. Ceram. Soc. 78</u>, 2293-2300 (1990).

30. R. K. Brow, R. J. Kirkpatrick, and G. L. Turner, "The short range structure of sodium phosphate glasses .I. MAS NMR studies," <u>J. Non-Cryst. Solids 116</u>, 39-45 (1990).

31. J. Lipowitz and G. L. Turner, "^{29}Si and ^{13}C magic angle sample spinning nuclear magnetic resonance spectroscopy of ceramic fibers prepared by prolysis of organosilicon polymers," in <u>Solid State NMR of Polymers</u>, L. J. Mathias, ed., Plenum Press, 305-320 (1991).

32. R. K. Brow, C. C. Phifer, G. L. Turner, and R. J. Kirkpatrick, "Cation effects on ^{31}P MAS NMR chemical shifts of metaphosphate glasses," J. Amer. Ceram. Soc. 74, 1287-90 (1991).

33. B.C. Bunker, R.J. Kirkpatrick, R.K. Brow, G.L. Turner, and C. Nelson, "Local structure of alkaline earth boroaluminate crystals and glasses: II. Boron-11 and aluminum -27 MAS NMR spectroscopy of alkaline earth boroaluminate glasses," J. Amer. Ceram. Soc. 74, 1430-8 (1991).

34. E. Oldfield, J. Chung, H. B. Le, T. Bowers, J. Patterson, and G. L. Turner, "Differential linebroadening in coupled carbon-13 magic-angle sample-spinning nuclear magnetic resonance spectra of solid polymers," Macromolecules, 25, 3027-30 (1992).

35. R. K. Brow, R. J. Kirkpatrick, G. L. Turner, "Nature of alumina in phosphate glass. II. Structure of sodium aluminophosphate glass," J. Amer. Ceram. Soc. 76(4), 919-28 (1993).

36. A. K. Jameson, C. J. Jameson, A. C. de Dios, E. Oldfield, R. E. Gerald, and G. L. Turner, "^{129}Xe magic-angle spinning of xenon in zeolite NaA. Direct observation of mixed clusters of co-adsorbed species," Solid State Nucl. Magn. Reson. 4(1), 1-12 (1994).

37. J. L. Bass and G. L. Turner, "Anion distributions in sodium silicate solutions. Characterization by ^{29}Si NMR, infrared spectroscopy and vapor phase osmometry," J. Phys. Chem., 101(50), 10638-10644 (1997).

38. J. L. Bass, G. L. Turner and M. D. Morris, "Vibrational and ^{29}Si NMR Spectroscopies of Soluble Silicate Oligomers," Macromol. Symp., 140, 263-270 (1999).

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DECLARATION OF DR. BALA DHANDAPANI

I, Bala Dhandapani, residing at 30 Marion Circle, Eastampton, NJ 08060, declare and state that:

1. I received a Bachelor of Science Degree in Chemical Engineering from Anna University, Madras, India. I received a Doctorate Degree in Chemical Engineering in 1993 and a Masters of Science Degree in Chemical Engineering in 1990 from the Clarkson University, Potsdam, NY.

2. From 1997 to present, I have been employed as a Project Manager at BlackLight Power Inc., Cranbury, NJ, where I manage and conduct synthesis and characterization of novel hydride compounds.

3. From 1994-1997, I was employed as a Postdoctoral Research Associate and Laboratory Coordinator at Virginia Tech, Blacksburg, VA, Environmental Catalysis and Materials Laboratory, where I conducted synthesis, characterization, testing and development of novel catalytic materials for various environmentally significant reactions. I also managed the research activities of the lab of 12 researchers, including doctoral, masters and undergraduate students.

4. From 1990 - 1993, I was employed as a Research Assistant at Clarkson University, Potsdam, NY, wherein I studied the application of foam and monolith substrates for environmental catalysis. I also designed and constructed a reactor system with advanced instrumentation.

5. From 1988-1990, I was employed as an Instructor/Teaching Assistant at Clarkson University, where I taught the following courses: Unit Operations Laboratory, Reaction Engineering and Analysis, Advanced Reactor Design, Heterogeneous Catalysis, Material Science and Corrosion Engineering Laboratory.

6. I am experienced on the following instrumentation: AMETEK Quad Mass Spectrometer; Varian 3700 Gas Chromatograph; ISI-40 Scanning Electron Microscope; Siemens D 500 X-ray Diffractometer; Micromeritics ASAP 2010 Chemi; CHNS-EA1180 Elemental Analyzer; Perkin Elmer PHI 5300 ESCA; BioRad FT-60 Infrared spectroscopy; Mariner ESI-ToF Mass Spectrometer; HP 5890 and 6890 Gas Chromatograph; HP1100 HPLC; and Kratos XSAM800 XPS.

7. My research experience includes the synthesis of novel materials including: high surface area catalytic materials including monometallic and bimetallic transition metal carbides, nitrides, phosphides, hydrides and sulfides; noble metals and transition metal oxides; active catalytic materials supported on alumina, activated carbon, silica and titania; and high surface area activated carbon and silica from various precursors.

8. My research experience also includes the characterization of materials using the following techniques: X-ray diffraction; X-ray photoelectron spectroscopy; FTIR spectroscopy; Electrospray Ionization Time of Flight Mass Spectroscopy; Time of Flight Secondary Ion Mass Spectroscopy; Solids Probe Mass Spectroscopy (Quadrupole,

Magnetic Sector and Time of Flight); Proton Nuclear Magnetic Resonance; Scanning Electron Microscopy; Physisorption and Chemisorption techniques; Temperature programmed experiments; and Conductivity measurements Inductively Coupled Plasma Mass Spectrometry (elemental analysis).

9.   My research experience further includes the development of catalytic materials, including: Optimization of synthesis conditions; Inclusion of additives, stabilizers and binders; and Fabrication of catalysts on monolith and foam substrates.

10.   My research experience further includes the testing and evaluation of catalysts, including: Ozone decomposition reaction; Hydrogenation of aromatic compounds; Hydrodenitrogenation (HDN), hydrodesulfurization (HDS), hydrodeoxygenation (HDO) of various model compounds at high pressure reaction conditions; Hydrodechlorination (HDC) of chlorofluorocarbons; and Reforming of methane using membrane and plug flow reactors.

11.   My research experience further includes kinetics and mechanism, including: Catalytic ozone decomposition reaction; Hydrogenation of isopropyl benzene; Simultaneous HDN, HDS and HDO of various heterocyclic aromatic compounds; and Hydrodechlorination of CFC-12 to HCFC-22 and HFC-32.

12.   A selected list of my publications is attached.

13.   I supervised the preparation of the compounds shown in the following Tables 1 and 2. Table 1 includes new compounds comprising hydrinos formed using catalysts for forming hydrinos (lower energy hydrogen) from hydrogen. The process used for forming the compounds comprising hydrinos is described in Dr. Randell L. Mills U.S. serial No. 09/009,294 and published PCT/US98/14029 application. Table 2 includes control compounds comprising conventional elements and energy states.

14.   Blind samples of the compounds were sent to Dr. Gary L. Turner of Spectral Data Services, Inc. to conduct Nuclear-Magnetic-Resonance (NMR) evaluation of the samples. The results of the NMR analysis is shown in the Tables 1 and 2.

Summary of new hydrino hydride compounds that showed novel features with solid state MAS ^{1}H NMR spectroscopy

Table 1

Compound	Data file	Reactants	^{1}HNMR Features
KHI	blps00as.14	KI, K, H_2	-2.5*, 1.1
KHI	blps0095.005	K, KI, H_2	-3.2*, 0.9
KHCl	bpls99as.078	K, KCl, H_2	-4.4*, 4, 1.1
KHBr	bpls99as.058	K, KBr, H_2	-4.1*, 5.9, 4.3, 1.2
RbHF	bpls99as.034	RbF, K, H_2	-4.4*, 1.2

* novel features

Summary of relevant controls performed

Table 2

Control Compound	Data File	^{1}H NMR Features
KH	blps00as.038	1.1, 0.8, 4.6
KH + KI	blps00as.099	1.1, 0.8, 4.5
KH + KCl	blps00as.097	1.1, 0.7, 4.3
KH + KBr	blps00as.101	1.1, 0.8, 4.2
RbH	textfr.1.txt	0.83, 4.0
RbH + RbF	blps00as.103	1.0, 4.9

1.1, 1.0, 0.8, 0.7 ppm is associated with M-H (where M is K or Rb),
4-4.9 ppm is associated with M-OH (where M is K or Rb)

15.   I analyzed XPS and TOFSIMS spectroscopy to determine the elements (cations and anions), such as the potassium and halides, present in each of the compounds. I also preformed a Gas Chromatograph (GC) to determine whether hydrogen present in each of the compounds.

CONCLUSIONS

16.   Negative numbers in the compounds of Table 1 represent an upfield shift, which means that the electron is closer to the proton in the hydrogen. Thus, the upfield chemical shifts observed by the NMR data indicate that new lower energy states for the hydride ions (hydrino hydride ions) may exist.

17.   I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

By _D. Bndamunpau_

Dr. Bala Dhandapani

Date: _8/14/2000_

SELECTED PUBLICATIONS

J. Y. Wang, B. Dhandapani, D-T. Chin, An Experimental Study of Mass Transfer in Pulse Reversal Plating, Journal of Applied Electrochemistry, 22, 240, 1992.

D-T. Chin and B. Dhandapani, An Experimental Study of Metal Distribution in Pulse Plating, Electrochemica Acta, 37, 1927, 1992.

B. Dhandapani and S. T. Oyama, Novel Catalysts for Selective Dehalogenation of CCl2F2 (CFC-12),Catal. Lett., 35, 353, 1995.

B. Dhandapani and S. T. Oyama, Kinetics and Mechanism of Ozone Decomposition on Manganese Oxide Catalyst, Chem. Lett., 413, 1995.

B. Dhandapani and S. T. Oyama, Gas Phase Ozone Decomposition Catalysts, Applied Catalysis: Environmental, 11, 129, 1997.

C. C. Yu, S. Ramanathan, B. Dhandapani, J. G. Chen and S. T. Oyama, Bimetallic Nb-Mo Hydroprocessing Catalysts: Synthesis, Characterization and Activity Studies, J. Phys. Chem., 101, 512, 1997.

J. Wen, B. Dhandapani, S. T. Oyama and G. L. Wilkes, Preparation of Highly Porous Silica Gel from Poly(tetra methylene oxide) (PTMO)/Silica Hybrids, Chem. Mater., 9, 1968, 1997.

B. Dhandapani, S. Ramanathan, C. C. Yu, J. G. Chen and S. T. Oyama, Synthesis, Characterization and Reactivity Studies of Supported Mo2C with Phosphorus Additive, J. Catal., 176, 1998.

B. Dhandapani, T. P. St.Clair and S. T. Oyama, Simultaneous Hydrodesulfurization, Hydrodeoxygenation and Hydrogenation with Molybdenum Carbide, Applied Catalysis, A: General, 168, 219, 1998.

Wei Li, B. Dhandapani and S. T. Oyama, Preparation and Characterization of Molybdenum Phosphide: A Novel Catalyst for Hydrodenitrogenation, Chem. Lett., 207, 1998.

T. P. St.Clair, B. Dhandapani and S. T. Oyama, Cumene Hydrogenation Turnover Rates on Molybdenum Carbide: CO and O2 as Probes of the Active Sites: Catal. Lett., 58, 169, 1999.

P. A. Clark, B. Dhandapani and S. T. Oyama, Preparation and hydrodenitrogenation performance of Rhenium Nitride, Applied Catalysis, A: General, 184, L 175, 1999.

B. Dhandapani, S. Ramanathan, C. C. Yu and S. T. Oyama, Study of Supported Bimetallic Oxycarbide Catalysts, submitted to Applied Catalysis.

B. Dhandapani, N. Greenig, J. He and R. Mills, Synthesis and Characterization of Novel Alkali Metal Halido Hydrides, submitted for publication, The International Journal of Hydrogen Energy.

B. Dhandapani, Wei Li and S. T. Oyama, Ozone Decomposition on Noble Metals and Metal Oxides, manuscript under preparation.

D-T. Chin, B. Dhandapani, J. Y. Wang, Mass Transfer in Pulse Reversal Plating, 42 nd ISE Meeting, Aug. 1991, Montreux, Switzerland.

B. Dhandapani and D-T. Chin, Experimental Study of Metal Distribution in Pulse Plating, , AIChE National Meeting, Nov. 1992, Miami, Florida.

B. Dhandapani, S. Ramanathan, C. C. Yu and S. T. Oyama, Hydrotreatment Reactions on Novel Carbide Catalysts, Tri-State Catalyst Club Symposium on Heterogeneous and Homogeneous Catalysis, May 1996, Charleston, WV.

B. Dhandapani, T. P. St.Clair and S. T. Oyama, Simultaneous Removal of Aromatics, Sulfur and Oxygen Compounds using Novel Carbide Catalysts, 212 th ACS National Meeting, August 1996, Orlando, Florida, USA.

B. Dhandapani, J. He and R. Mills, Synthesis and Characterization of Novel Hydrides, 45 th ACS, Western Regional Meeting, Oct 1999, Ontario, California, USA.

B. Dhandapani, N. Greenig, J. He and R. Mills, Novel Alkaline and Alkaline Earth Hydrides, National Hydrogen Association, February 2000, Vienna, Virginia, USA.

B. Dhandapani, M. Nansteel, J. He and R. Mills, Novel Inorganic Hydrides, ACS National Meeting, March 2000, San Francisco, California, USA.

DECLARATION OF DR. JONATHAN PHILLIPS

For: VERIFICATION OF POWER GENERATION BASED ON DR. RANDELL L. MILLS' HYDRINO TECHNOLOGY

I, Jonathan Phillips, residing at 700 Avenida Castellano, Santa Fe, New Mexico, declare and state that:

1.   I received a Bachelor of Arts degree in physics from Middlebury College, Middlebury, Vermont, in 1976, and a Masters of Science and Doctorate degrees in Materials Science at the University of Wisconsin, Madison, Wisconsin, in 1977 and 1981, respectively.

2.   I have been a national lab professor at the University of New Mexico in the Department of Chemical and Nuclear Engineering since March 1999.

3.   I am a technical staff member at Los Alamos National Lab, Los Alamos, New Mexico, where I serve as project leader on a material aging project.

4.   I am currently on a two year leave of absence from my position as a full Professor of Chemical Engineering at the Pennsylvania State University, University Park, Pennsylvania, where I have been a member of the faculty since 1982.

5.   I have published over 70 peer-reviewed scientific papers, and have conducted research for over 23 years in various areas, including multimetallic catalytic chemistry and structure, catalytic etching, carbon surface chemistry, plasma physics and chemistry, materials modification by plasmas, as well as microcalorimety and Mossbauer spectroscopy. My research is currently supported by the U.S. National Science Foundation, the U.S. Department of Energy, and individual corporations through the NSF center for Ceramic and Composite Materials co-located at the University of New Mexico and Rutgers University.

6.   I was a Fulbright Fellow at the Ben Gurion University of the Negev in 1997-98.

7.   Experiments were conducted to test the hypothesis that in the gas phase potassium ions will catalyze the conversion of hydrogen atoms to hydrino atoms. These experiments were initially carried out in a Calvet cell as this type of calorimeter is highly sensitive and accurate. Moreover, the conditions of the calorimeter are controlled.

8.   Dr. Randell L. Mill's theory of hydrino formation requires a catalyst, such as two gaseous K+ ions, and H-atoms. In order to generate gaseous K+ ions, KNO_3 was placed in a small (2cc) quartz 'boat' inside the calorimeter cell. The boat was heated, to increase the vapor concentration of KNO_3, with a platinum filament, which

was wound around the boat. A second function of the platinum filament was to generate H-atoms. It is well known that hydrogen molecules in contact with a heated filament will decompose, yielding a relatively high H-atom concentration in the boundary layer around the filament. Thus, according to Dr. Mills' model, in a cell containing KNO_3 in the boat and vapor phase hydrogen, there is a small region in the boundary layer around the heated metal filament which should contain sufficient concentrations of both H-atoms and K+ ions for hydrino formation to occur.

9. Calorimetric considerations require that a stable baseline exists before the heat generating process is initiated. Thus, signal change away from the baseline can be correlated to the onset of the process under investigation. In the present experiments the cell was run with KNO_3 in the boat and the filament fully 'powered'. The calorimeter was allowed to equilibrate until a steady baseline existed. The 'hydrino formation' process was initiated by then adding gaseous hydrogen.

10. In the present experiment, data was obtained which indicates that heat evolved upon the introduction of hydrogen to the Calvet calorimeter cell. In contrast, no heat was evolved upon the admission of helium. Repeated calibrations were also conducted. Thus, it appears that the Dr. Mills' hypothesis is consistent with the present results.

EXPERIMENTAL SYSTEM

11. <u>Calvet Calorimeter</u>. The Calvet-type calorimeter employed in this study was similar to one described in my earlier reports to Hydrocatalysis Corporation (now BlackLight Power, Inc.), entitled "Additional Calorimetric Examples of Anomalous Heat From Physical Mixture of K/Carbon and Pd/Carbon," January 1, 1996. In essence a stainless steel cup of almost exactly 20 cm³ volume was placed in a calorimeter well such that the cup is surrounded by thermopiles on its sides and bottom. The cup and calorimeter are surrounded by a thick layer of insulation, and the entire device is placed inside a commercial convection oven. In all cases experiments were conducted with the oven temperature set to 250°C.

12. <u>Reaction cell</u>. For these experiments the top of the calorimeter cup/reactor cell was fitted with a Conflat knife edge flange. The top element of the flange is connected to a gas supply system outside the convection oven with a 0.5 cm OD ss tube, and with two welded vacuum high current copper feedthroughs. The feedthroughs were connected on the cup side of the flange to a coiled section of 0.25 mm platinum wire approximately 18 cm in length. Fitted inside the coiled platinum was a small quartz boat into which 200 mg of powdered KNO_3 were placed.

13. <u>Plumbing</u>. On the outside of the oven the gas feed through is connected to a line

leading to hydrogen and helium tanks, a pressure gauge, and a standard vacuum roughing pump. It is notable that the gas lines were all well insulated, both inside the oven, and for about 50 cm outside the oven. The plumbing system was so arranged that the cell could be evacuated, and then isolated from the pump in such a way that hydrogen or helium could be added directly from high purity gas tanks. Great care was taken before the experiments were initiated to evacuate and flush the gas lines several times. It was also determined that the lines held gas pressure, with no loss in pressure, for several days. That is, there were no leaks.

RESULTS

14.   <u>Calvet Calorimeter</u>. The Calvet studies suggest large amounts of heat are generated upon the admission of hydrogen to the cell. In contrast, virtually no heat is observed upon admission of helium to the cell.

15.   Calibration. The first tests performed on the Calvet system were electrical calibration experiments. The system was set-up for full experimentation: KNO_3 was in the boat, the system was evacuated, and 10 watts of steady power were supplied to the platinum coil. After a steady baseline was achieved (approximately 10 hours after the oven was adjusted to 250°C), the cell was isolated from the pump and the pressure allowed to equilibrate (approximately 100 Torr). This did not appear to impact the baseline in any fashion. The power supply was then adjusted to deliver an additional 1 watt (11 watt rather than 10) for a specified time period. The power was then returned to the original 10 wall setting. A typical response curve is shown in Figure 1. The area under the response curve can be used to obtain a calibration constant which relates signal area increase to the number of extra Joules delivered. This was done in four cases (Table I). As can be seen, there is some error (+/-15%) in the calculated calibration constant.

16.   Control Studies. Helium was admitted, approximately 10 psig, to the cell to test the impact of a change in pressure, and heat transfer characteristics on the response of the cell. The helium was admitted after the cell had been isolated from the pump for a considerable time and a steady pressure (approximately 100 Torr) achieved. As can be seen in Figure 2a, the response was a short-lived small increase in output signal, followed by a relatively short time period during which the signal gradually returns to the original baseline. Within an hour the signal returned to the original baseline, with some drift evident.

17.   The response of the system was expected. The helium increased the rate of heat transfer away from the platinum filament, and heated boat. Thus, the initial addition of helium to the system resulted in a temporary increase in the amount of heat reaching the thermopiles. That is, the boat and the filament cool off; until such time as the boat and filament have reached their new steady state temperatures. The

steady state temperature of the boat and filament are a function of heat transfer mechanism. After the admission of helium most heat transfer was occurring by convection to the walls. Before the admission of helium a considerable fraction was by radiation. Radiative transfer of 10 watts requires a higher filament/boat temperature than does convective heat transfer.

18. Figure 2b illustrates again the impact of adding pressure, or removing gas, from the system. Upon the addition of helium there was a very short lived increase in heat reaching the thermopiles. Upon pumping there was a period of time, perhaps an hour, during which the heat signal went below the baseline. This is consistent with the model in that pumping makes convective and diffusive heat transfer minimal. Virtually all heat transfer was by radiation, which requires that the filament/boat temperature increase. It took some time for this new steady-state temperature to be reached.

19. Hydrogen Admission. Hydrogen admission was carried out in much the same fashion as helium admission. The cell reached an equilibrium pressure, approximately 100 Torr, and then hydrogen at 10 psig was admitted to the cell. The valve to the hydrogen source, which was a steel line 4 meters by 0.6 cm OD, was closed off by a valve in front of the regulator during admission. Moreover, it was open for only a couple of seconds in each case. This was done on three separate occasions, and the signal that evolved in response to these three processes was recorded in Figures 3, 4 and 5. One other observation recorded was that the pressure decreased gradually over time, such that after about an hour the pressure returned to the original equilibrium pressure of the cell. It must also be noted that the heat production was ended deliberately in all three cases by pumping the system to 5×10^{-3} Torr. It is clear 'excess heat' evolution would have continued in all cases if the system had not been evacuated.

20. It was expected that in the absence of reaction that the response of the cell to the addition of hydrogen would be similar to that observed for helium. Indeed, given that pressure measurements suggest that most hydrogen was adsorbed, or in some other fashion removed from the cell after an hour, even heat transfer effects should be totally transitory. Even in the event of reaction no more than a small heat signal was expected. Indeed, a high end estimate is that 25 cm^3 of hydrogen at a temperature of 300°K and a pressure of 2 atmospheres entered the cell. This is equivalent to 2×10^{-3} moles of hydrogen. If all of that hydrogen interacted with oxygen to form water only 510 J would be generated. It is possible to imagine that the hydrogen could interact with nitrogen in the KNO_3 to form ammonia. However, even less energy would evolve from this process. Thus, the largest heat peak expected was 0.5 watts for 1000 seconds (approx. 17 minutes). A block of this size is marked on Figure 3.

21. It is clear from figures 3, 4 and 5 that hydrogen admission to the cell produced far

more energy evolution than can be explained by any conventional chemical process. It is interesting in this regard to graphically contrast the response of the system to helium admission to the response to that for hydrogen admission. This is done on Figure 6 in which Figure 3 and Figure 2a are superimposed.

DISCUSSION

22. The evidence presented in this report clearly suggests that a phenomenon takes place upon the admission of hydrogen to a cell containing a heated platinum filament and KNO_3. This phenomenon appears to generate heat in excess of that expected from any known chemical process, given the content of the reactants in the cell.

23. I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

By _____
Dr. Jonathan Phillips

Date: _____July 20, 2000_____

Typical Calibration Experiment: 1 W Input, 20 Mins

Table 1	1 Watt Input Calibration Data			
	30 min	20 min	20 min	10 min
Cal. Const	0.2270	0.2765	0.2130	0.2718
Deviation	-8.13	11.90	-13.79	10.02
	Average	0.2471		

Signal (V)

4.5 4 3.5 3 2.5 2 1.5 1 0.5 0

Time (min)

480.67 482.50 484.33 486.17 488.00 489.83 491.67 493.50 495.33 497.17 499.00 500.83 502.67 504.50 506.33 508.17 510.00 511.83 513.67 515.50 517.33 519.17 521.00 522.83 524.67 526.50 528.33 530.17 532.00 533.83 535.67 537.50 539.33 541.17 543.00

Figure 1

Report on Calorimetric Investigations of Hydrino Formation

Heat Production, KNO3 w/ Helium Injection (BL1220A)

A Begin collecting a 5 min baseline
   Pinitial = 100 Torr
B Inject He to 1+ atm
C Pressure stays at 1+ atm, begin
   pumping. System pumped down
   to 300 mTorr, pressure slowly
   raises back to 1 Torr

Total Time = 6050 seconds
Total Energy = 326.18 Joules
Average Output = 0.0539 Watts

Output (Watts)

Time (min)

Figure 2A

Report on Calorimetric Investigation of Hydrino Formation

Heat Production, KNO3 w/ Helium Injection (BL1219B)

A Begin collection 10 min baseline
   Pinitial = 170 Torr
B Inject Helium, P = 1+ atm
C Begin pumping, 1 min
   Pressure pumps down to 300 mTorr
D Pressure increases, stabilizes at
   P = 1 Torr

Figure 2B

Report on Calorimetric Investigations of Hyrdino Formation

Heat Production, KNO3 w/ H2 Injection (BL1218CD)

A   Inject H2 to 1+ atm
    Pinitial = 110 Torr
B   Pressure reducing, P = 1atm
C   Pressure reducing. P = 300 Torr
D   Pressure reducing, P = 200 Torr
E   Pressure stabilizes, P = 170 Torr
F   Begin pumping, 15 seconds

Total Time = 36740 seconds
Total Energy = 21559.63 Joules
Average Output = 0.5868 Watts

Time (min)

Output (Watts)
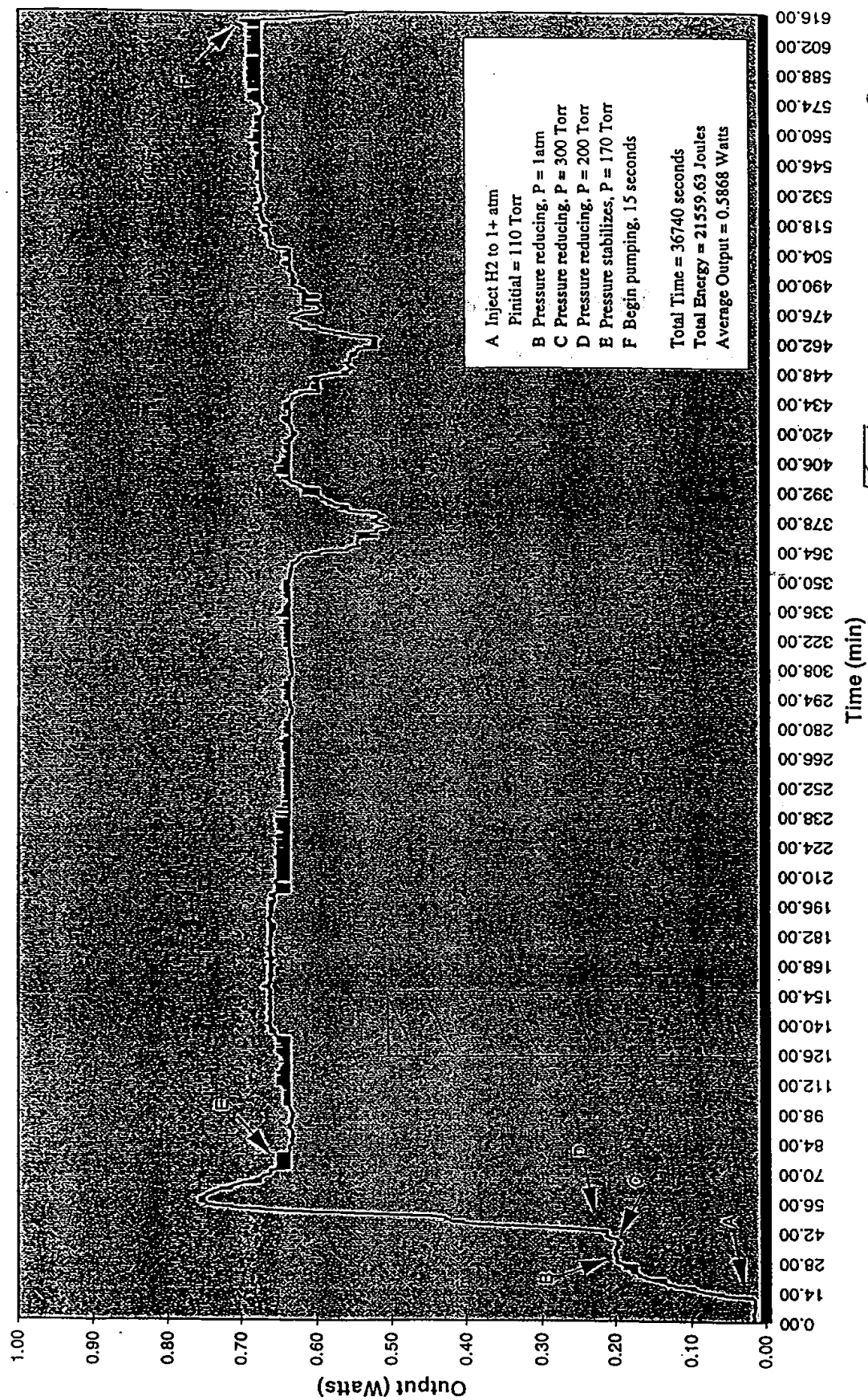
⬜ — Peak area expected if all admitted H₂ reacts with O₂ to form H₂O.

Figure 3

Report on Calorimetric Investigations of Hydrino Formation

Heat Production, KNO3 w/ H2 Injection (BL1220BC)

A Inject H2 to 1+ atm
   Pinitial = 100 Torr
B Pressure reducing, P = 600 Torr
C P = 180 torr
D Pressure stabilizes, P = 170 Torr
E Begin pumping, 60 min

Total Time = 21820 seconds
Total energy = 13002.79 Joules
Average Output = 0.5959 Watts

Figure 4

Report on Calorimetric Investigations of Hydrino Formation

Heat Production, KNO3 w/ H2 Injection (BL1221AB)

A Inject H2 to 1+ atm
   Pinitial = 10 Torr
B Pressure decreases, then
   stabilizes.
   Pfinal = 120 Torr
C Begin pumping system
D Close pump valve
   Pumping time = 10 minutes

Total Time = 17020 seconds
Total Energy = 10292.52 Joules
Average Output = 0.6047 Watts

Figure 5

Report on Calorimetric Investigations of Hydrino Formation

Heat Production, KNO3 w/ H2 and He Injection (BL1218CD,BL1219B)
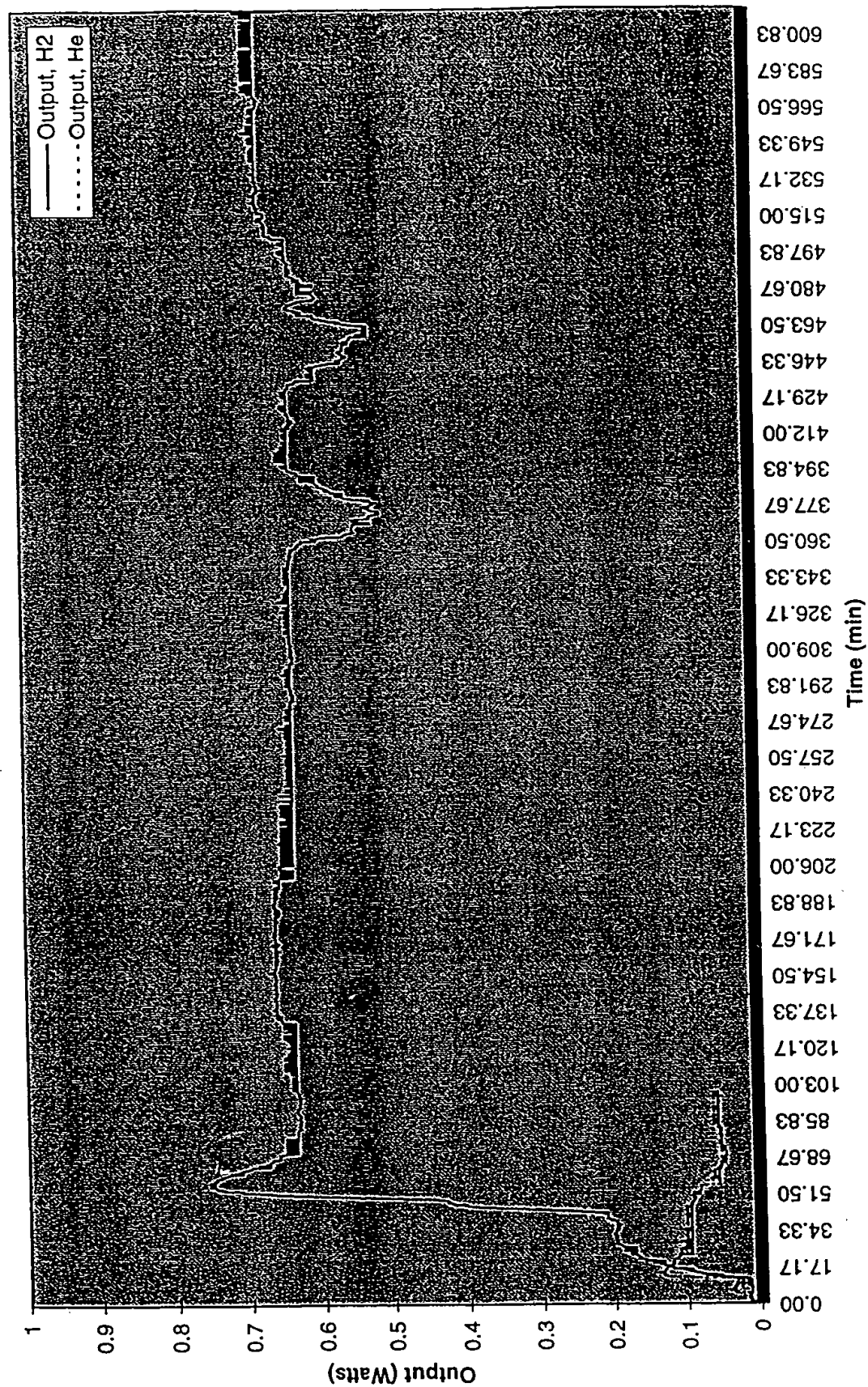
Figure 6

U.S. Serial No. 09/362,693
Inventor: Mills

52. Briefs filed in Applicant's appeal to the Federal Circuit in *BlackLight Power, Inc. v. Q. Todd Dickenson*, Appeal No. 00-1530

53. Letter to Director Esther Kepplinger dated March 28, 2000.

54. Letter to Director Esther Kepplinger dated January 19, 2001.

55. Letter of February 12, 2001 from Director Jacqueline M. Stone.

56. Pages 26-33 of Applicant's Appeal Brief filed in serial No. 09/220,970.

57. C.A. Fuchs and A. Peres, "Quantum Theory Needs No "Interpretation," Physics Today, March (2000), p. 70

58. S. Durr, T. Nonn, G. Rempe, Nature, September 3, (1998), Vol. 395, pp. 33-37.

59. Weisskopf, V. F., Reviews of Modern Physics, Vol. 21, No. 2, (1949), pp. 305-315.

60. M. Karplus and R. N. Porter, *Atoms and Molecules an Introduction for Students of Physical Chemistry*, The Benjamin/Cummings Publishing Company, Menlo Park, California, (1970), p. 567.

61. Beiser, A., *Concepts of Modern Physics*, Fourth Edition, McGraw-Hill Book Company, New York, (1978), p. 407.

IN THE

UNITED STATES COURT OF APPEALS

FOR THE FEDERAL CIRCUIT

BLACKLIGHT POWER, INC.,

Plaintiff-Appellant,

v.

Q. TODD DICKINSON,
Director, Patent and Trademark Office,

Defendant-Appellee.

Appeal from the United States District Court for
the District of Columbia in 00-422 (EGS),
Judge Emmet G. Sullivan

BRIEF FOR PLAINTIFF-APPELLANT
BLACKLIGHT POWER, INC.

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November 6, 2000

CERTIFICATE OF INTEREST

Counsel for the Plaintiff-Appellant certifies the following:

1.   The full name of every party represented by us is:

BlackLight Power, Inc.

2.   The name of the real party in interest (if the party named in the caption is not the real party in interest) represented by us is:

BlackLight Power, Inc.

3.   All parent corporations and any publicly held companies that own 10 percent or more of the stock of the party represented by us are:

None

4.   The names of all law firms and the partners or associates that appeared for the parties now represented by us in the trial court or agency or are expected to appear in this court are:

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STATUTES AND RULES

STATEMENT OF RELATED CASES

No appeal in or from the same Civil Action No. 00-422 (EGS) (D.D.C.) was previously before this Court or any other appellate court. In this same appeal, the Court previously denied Plaintiff-Appellant BlackLight Power, Inc.'s motion for an injunction pending appeal. *BlackLight Power, Inc. v. Dickinson*, No. 00-1530 (Fed. Cir. Aug. 31, 2000) (nonprecedential).

Counsel knows of no other case pending in this Court or any other court that may directly affect, or be directly affected by, the Court's decision in this appeal.

JURISDICTIONAL STATEMENT

The U.S. District Court for the District of Columbia had jurisdiction over the civil action giving rise to this appeal pursuant to 28 U.S.C. §§ 1331 and 1338(a).

The U.S. Court of Appeals for the Federal Circuit has jurisdiction over this appeal pursuant to 28 U.S.C. § 1295(a).

The notice of appeal from the final judgment entered August 15, 2000, was timely filed in accordance with 28 U.S.C. § 2107(b) and Fed. R. App. P. 4(a) on August 24, 2000. (A33; A907.)

I.   STATEMENT OF THE ISSUES

1.   Whether the PTO violated the plain language of 35 U.S.C. § 151, which commands that the "the patent shall issue" once the issue fee has been paid, by withdrawing BlackLight's patent applications from issue after payment of the issue fee?

2.   Whether the PTO's regulation in 37 C.F.R. § 1.313(b)(3), which allows the PTO to withdraw a patent application after the issue fee has been paid on grounds of "unpatentability," is invalid as contrary to the statutory command in section 151?

3.   Whether the PTO violated its own regulation in section 1.313(b) when it withdrew BlackLight's '294 application after payment of the issue fee without determining whether any of the claims are unpatentable?

4.   Whether the PTO acted arbitrarily and capriciously when it withdrew BlackLight's '294 application after payment of the issue fee in response to an outside inquiry and without ever reviewing the application file?

II. STATEMENT OF THE CASE

A. Preliminary Statement

This appeal arises from the illegal actions of the Patent and Trademark Office (PTO) in withdrawing from issue certain patent applications assigned to Plaintiff-Appellant BlackLight Power, Inc., after BlackLight had already paid the issue fees. Prompted by an outside inquiry, the PTO pulled BlackLight's application Serial No. 09/009,294 ('294 application) from issue without ever determining that the claims were unpatentable or even reviewing the relevant facts. In doing so, not only did the PTO follow what the district court termed "suspicious procedures," but its actions also violated the plain language of 35 U.S.C. § 151, which states that "the patent shall issue" once the issue fee has been paid.

Even if the PTO had the authority to withdraw the applications from issue, it violated its own regulations. 37 C.F.R. § 1.313(b)(3), on which the PTO purportedly relied, provides that, after the applicant has paid the issue fee, the application will not be withdrawn from issue for any reason except the "[u]npatentability of one or more claims." The PTO, however, never determined that any of the claims of BlackLight's '294 application was unpatentable before withdrawing it from issue. Indeed, it could not have made any such determination because the PTO Director who made the decision to withdraw the application never saw the application file.

Despite these clear violations of the statute and the PTO's own regulations, the District of Columbia District Court granted summary judgment to the PTO on BlackLight's claims under the Administrative Procedure Act (APA), 5 U.S.C. § 701, et seq. Although the district court was clearly troubled by the "seemingly suspicious procedures" followed by the PTO in withdrawing BlackLight's patent applications, it excused the PTO's actions, finding that the regulation permitted withdrawal based

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only on a "possibility of unpatentability." This strained interpretation of the regulation would render it meaningless and allow the PTO to reopen prosecution on a whim, or, as it did here, based on hearsay information received from outside the PTO without even reviewing the file. At the very least, the PTO acted arbitrarily and capriciously in failing to review the relevant facts before deciding to withdraw BlackLight's '294 application.

Accordingly, the district court's grant of summary judgment should be reversed and the case remanded to the district court with instructions to set aside the PTO's illegal actions in withdrawing BlackLight's patent applications from issue and to direct that these applications issue as patents.

B. Nature of the Case, Course of Proceedings, and Disposition Below

BlackLight filed this suit on March 1, 2000 in the District of Columbia District Court against Q. Todd Dickinson, in his capacity as the Commissioner of Patents and Trademarks,[1] for violations of the Administrative Procedure Act (APA), 5 U.S.C. § 701, *et seq.*, by the PTO. (A35-47.) BlackLight sought both preliminary and permanent injunctive relief directing the PTO to issue BlackLight's patent application Serial Nos. 09/009,294, 09/008,947, 09/009,455, 09/009,678, and 09/111,160. BlackLight also sought a declaratory judgment that the PTO's withdrawal of its applications and the PTO's regulation permitting withdrawal were contrary to 35 U.S.C. § 151, and that the PTO's actions in this case were arbitrary and capricious and in violation of its own regulation. (*Id.*)

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[1] Effective March 29, 2000, P.L. No. 106-113 created the United States Patent and Trademark Office as a performance-based organization within the Department of Commerce and changed the title of the head of the agency from "Commissioner" to "Director." *See* 35 U.S.C. § 3(a)(1).

BlackLight also filed a motion for a temporary restraining order and preliminary injunction against the PTO. (A54-A66.) At a hearing before the district court on March 3, 2000, the parties agreed that BlackLight would withdraw its motion without prejudice in return for the PTO's agreement to refrain from taking any official action with respect to BlackLight's pending applications until June 2, 2000. (A67-78; A79.) The parties extended their standstill agreement several times until August 24, 2000, but the PTO refused to refrain from taking any action after that date.

On August 15, 2000, the district court (Judge Emmet G. Sullivan) issued its decision on the parties' cross-motions for summary judgment, granting summary judgment for the Commissioner. (A1-26.) The district court's decision is reported at *BlackLight Power, Inc. v. Dickinson*, 109 F. Supp.2d 44, 55 USPQ2d 1812 (D.D.C. 2000). After the district court's summary judgment, with time running out on the standstill agreement, BlackLight renewed its motion for an injunction against the PTO, or in the alternative, a stay pending appeal. The district court denied BlackLight's motion (A905), and this appeal followed (A907).

BlackLight's motion for an injunction pending appeal was also denied by this Court. *BlackLight Power, Inc. v. Dickinson*, No. 00-1530 (Fed. Cir. Aug. 31, 2000) (nonprecedential). The Court concluded that BlackLight would not sustain any irreparable harm if the PTO reopened prosecution because BlackLight has an effective remedy if the Court rules in its favor on the merits. Slip op. at 5. In view of the lack of irreparable harm, the Court also ruled that BlackLight had not shown a "strong likelihood of success" merits. Slip op. at 5-6. Since then, the PTO has issued Office Actions rejecting the claims in each of BlackLight's five patent applications.

III. STATEMENT OF THE FACTS

A.   BlackLight Power, Inc.

Plintiff-Appellant BlackLight Power, Inc. is a leader in the field of energy technology. Since 1991, BlackLight has spent over $10 million researching and developing new ways to obtain energy from hydrogen and new compositions of matter formed from hydrogen. (A36-37; A50.) The funding for this research has come from such well-known companies as AMP Corporation, Connectiv, and PacificCorp. (A37; A50; A158-59; A593; A810-11.) Rigorous testing of BlackLight's technology by numerous independent laboratories, including one of Germany's top physicists, has demonstrated that it is based on sound scientific principles. (A37-38; A50; A159; A811.)

Indeed, BlackLight has been built on a rock-solid foundation of top-notch scientists and leaders in chemistry and physics. (A50.) Its board members include a former Assistant Secretary of the Department of Energy, a former Assistant Secretary of the Department of the Navy, and a retired Navy Vice Admiral who currently serves on the Defense Science Board and the Naval Studies Board of the National Academy of Science. (A35-36; A50-51.) Many of BlackLight's shareholders are PhD. chemists and physicists. (A36; A51.) BlackLight's founder and CEO, Dr. Randell L. Mills, has a medical degree from Harvard University and has published numerous papers on hydrogen and energy technology. (A462-66.) In October 1999, Dr. Mills addressed the American Chemical Society, during which he presented the results of BlackLight's research to an enthusiastic and receptive audience. (A37; A50.)

BlackLight's current private market capitalization exceeds $340 million. (A50.) In March 2000, BlackLight was prepared to go public, with an initial public

offering underwritten by Morgan Stanley Dean Witter that was expected to exceed $1 billion based on market conditions. (A40; A50; A158.) Since the PTO withdrew BlackLight's patent applications from issue, however, as explained below, the IPO was halted. (A158.) The PTO's withdrawal of BlackLight's applications has also interfered with business relationships between BlackLight and potential licensees of BlackLight's technology. (A158-59.)

B.   BlackLight's Patent Applications

BlackLight is the assignee of five patent applications, including Serial No. 09/009,294 ('294 application), titled "Hydride Compounds." (A270-396; A478-518.) This application, as well as application Serial Nos. 09/008,947, 09/009,455, 09/009,678, and 09/111,160, relate to BlackLight's technology that uses a catalytic reaction of hydrogen to create new compositions of matter. These new compositions of matter comprise a hydride ion having a binding energy greater than about $0.8eV$, which the inventor, Dr. Mills, calls a "hydrino hydride." The new compositions include conductive magnetic plastics, which are useful in electronic circuitry and aerospace engineering, and high-strength coatings that are resistant to corrosion. (A37; A126-27.)

During the catalytic reaction that produces the new compositions, a significant amount of energy is released, which can be used for a number of different purposes, including generating electricity. (A37; A126.) On February 15, 2000, BlackLight received U.S. Patent No. 6,024,935 ('935 patent), titled "Lower-Energy Hydrogen Methods and Structures," which relates to methods and apparatus for releasing energy from hydrogen atoms. (A210-69.) During prosecution of the '935 patent, BlackLight's patent attorney cited and discussed with the patent examiner over 130 prior art articles relating to the concepts of "cold fusion" and "perpetual motion."

(A127; see A38; A51-52.) In particular, BlackLight's attorney discussed with the examiner extensive experimental results demonstrating the operability of the new chemical process, as well as spectroscopy data confirming the existence of the new hydrides created by the process. (A127-28; see A467-68.) The examiner concluded that the application for the '935 patent did not encompass concepts of "cold fusion" or "perpetual motion" and allowed the application to issue. (A38; A51-52; A128.)

Similarly, during prosecution of the '294 application, which was filed on January 20, 1998, BlackLight's attorney cited the same references concerning "cold fusion" and "perpetual motion" that had been cited in the '935 patent. (A51; A128; see A38.) A second examiner raised issues related to operability of the disclosed technology under 35 U.S.C. § 101. (A129; A398-401.) Dr. Mills and BlackLight's attorney conducted an interview with the second examiner, where they again discussed the extensive experimental results positively identifying the new compositions of matter claimed in the '294 application. (A51; A129; A520; see A467-68; A471-72.) They also showed the examiner physical samples of the new compositions, including a plastic-like material that strongly reacts to a magnetic field. (A467; A471.)

On October 18, 1999, the PTO issued a "Notice of Allowance and Issue Fee Due" for the '294 application. The Notice reads:

> THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.
>
> THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE . . .

(A135.) BlackLight paid the issue fee three days later on October 21, 1999 (A136), and the '294 application was set to issue as U.S. Patent No. 6,030,601 on February 29, 2000 (A155-56).

On February 17, 2000, twelve days before the '294 application was to issue, Frances Hicks, a Petitions Examiner with the Office of Petitions, issued a Notice withdrawing the application from issue under 37 C.F.R. § 1.313. (A48.) Although § 1.313(b)(3) provides for the withdrawal of an application after the issue fee has been paid due to "[u]npatentability of one or more claims," the February 17 Notice says nothing about the claims or their unpatentability. It states only that "[t]he application is being withdrawn to permit reopening of prosecution," and that the "withdrawal was requested by the Director, Special Program Law Office." (*Id.*)

Indeed, it is undisputed that Esther Kepplinger, the Director of Technology Center 1700 who was actually responsible for the decision to withdraw the '294 application, never reviewed the contents of the application because the file could not be located. (A3; A40; A51-53; A131; A551.) When asked about her decision, Ms. Kepplinger revealed that it was the result of some perceived "heat" from an undisclosed, outside source in response to issuance of the '935 patent. (A51; A131; but see A552.)[2]

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[2] For purposes of the summary judgment motion before the district court, BlackLight retracted the argument that the PTO had withdrawn the '294 application in response to outside pressure. (A4 n.1; A751-52.) Since then, however, the PTO has conceded that the review of the '294 application was prompted by an outside inquiry from a reporter. (A808 n.12; A853 n.10; see A810-12.) It was also later revealed that Dr. Robert Park of the American Physical Society, who is quoted in the article cited by the PTO (A811), had communicated with the PTO through an unidentified contact he referred to as "Deep Throat" (A826).

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Robert Spar, the Director of Special Programs, later confirmed that he had ordered the issuance of the February 17 Notice withdrawing the '294 application pursuant to Ms. Kepplinger's request. (A131; see A147.) Mr. Spar also admitted that he had not reviewed the '294 application. (A132; A555.) He apparently believed that the '294 application was directed to "cold fusion," which was the same argument that had already been raised and disposed of during prosecution. (A51; A131; A555.)

C. The PTO's Decision

After investigating the suspicious circumstances surrounding the withdrawal of the '294 application, BlackLight's counsel formally requested reconsideration of the withdrawal in letters to Ms. Kepplinger, Mr. Spar, and Q. Todd Dickinson, the Commissioner of Patents and Trademarks. (A49-53; A144-45; see A132-33.) BlackLight's counsel met again with Ms. Kepplinger, who conceded that she still did not have the '294 application file. (A133.)

The PTO treated BlackLight's letters as a single petition requesting that the Commissioner exercise his supervisory authority and reverse the PTO's withdrawal decision. In a decision dated March 22, 2000, the PTO denied BlackLight's petition and maintained that the '294 application was withdrawn from issue. (A146-54.) Specifically, in the March 22 decision, Assistant Deputy Commissioner Stephen G. Kunin reviewed the actions of Ms. Kepplinger and concluded that she did not act improperly in withdrawing the '294 application and issuing the February 17 Notice. (A153.)

Although the March 22 decision states that the withdrawal was "due to the Director's [Ms. Kepplinger's] determination that one or more claims lacked patentability" (A150), that clearly was not true since Ms. Kepplinger never even saw the file for the '294 application. Indeed, nothing in Ms. Kepplinger's declaration

indicates she ever made an actual determination of unpatentability of any of the claims, but rather she had some vague "patentability concerns." (A552.) According to the March 22 decision, Ms. Kepplinger became aware of the '935 patent, which had already issued, and questioned whether it was based on known scientific principles. (A147.) Without even knowing what the '294 application disclosed or the scope of the allowed claims compared to the '935 patent, this was enough to raise in her mind a "substantial question of patentability" concerning the '294 application. (A147.) Thus, the March 22 decision implicitly acknowledges that there had been no determination of the unpatentability of the '294 claims, only that "[a]n Office Action addressing the merits of the application *or* a supplemental Notice of Allowance will issue in due course." (A153; emphasis added.)

D.   District Court Proceedings

On March 1, 2000, BlackLight filed suit in the District of Columbia District Court against the Commissioner for violations of the Administrative Procedure Act (APA), 5 U.S.C. § 701, *et seq.*, by the PTO. (A35-47.) BlackLight claimed that the PTO did not have the authority to withdraw BlackLight's patent applications from issue after it had paid the issue fees, and that the PTO's regulation permitting withdrawal was contrary to 35 U.S.C. § 151, which states that, "[u]pon payment of [the issue fee] the patent *shall* issue." (Emphasis added.) Further, BlackLight claimed that, even if the Commissioner did have the authority to withdraw an application from issue, the PTO's actions in this case were arbitrary and capricious and in violation of its own regulation.

On August 15, 2000, the district court (Judge Emmet G. Sullivan) issued its decision on the parties' cross-motions for summary judgment. *BlackLight Power, Inc. v. Dickinson*, 109 F. Supp.2d 44, 55 USPQ2d 1812 (D.D.C. 2000). (A1-26.) The

court granted summary judgment for the Commissioner, holding that, contrary to the plain language of the statute which says that a patent "shall" issue, the PTO's interpretation allowing it to withdraw an application after the issue fee has been paid was "reasonable." *Id.* at 48, 50, 55 USPQ2d at 1815, 1817. (A10; A14.) In addition, the court held that the PTO's actions were not arbitrary and capricious, although the court was clearly troubled by the "seemingly suspicious procedures" followed by the PTO in withdrawing the '294 application. *Id.* at 54 n.10, 55 USPQ2d at 1820 n.10. (A25 n.10.) Nevertheless, the court concluded that the regulation permitting withdrawal based on "[u]npatentability of one or more claims," 37 C.F.R. § 1.313(b)(3), requires only "a possibility of unpatentability," 109 F. Supp.2d at 54, 55 USPQ2d at 1820 (A25), since there was never a determination that any of the claims of the '294 application are unpatentable.

IV. SUMMARY OF THE ARGUMENT

In reviewing the district court's grant of summary judgment, this Court need not defer to either the district court's or the PTO's interpretation of 35 U.S.C. § 151. The PTO's actions in withdrawing BlackLight's patent applications from issue after payment of the issue fees violated the plain language of section 151 commanding that "the patent shall issue" upon payment of the issue fee. The regulation on which the PTO purportedly relied to withdraw BlackLight's '294 application, 37 C.F.R. § 1.313(b)(3), is contrary to the statutory mandate in section 151 and is therefore invalid.

Moreover, the PTO did not follow its own regulation, which provides that, after payment of the issue fee, the application will not be withdrawn from issue for any reason except the "[u]npatentability of one or more claims." There is nothing in the

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administrative record that shows anyone at the PTO ever determined that the claims of the '294 application are unpatentable before it withdrew the application.

Finally, the PTO acted arbitrarily and capriciously in withdrawing BlackLight's '294 application in response to an outside inquiry from a reporter and without ever reviewing the application file. No one at the PTO reviewed the relevant facts, and there is no rational connection between the facts actually relied on by the PTO and the decision to withdraw the application.

V.   ARGUMENT

A.   This Court Should Not Defer to Either the District Court or the PTO

In reviewing the district court's grant of summary judgment, this Court reviews the judgment *de novo* without deference to the district court's decision. *See, e.g., Johnson Worldwide Assocs. v. Zebco Corp.*, 175 F.3d 985, 988, 50 USPQ2d 1607, 1609 (Fed. Cir. 1999). Since the decision below turns on statutory interpretation, which is a question of law, this Court interprets the statute independently without deference to the district court. *See Glaxo Operations UK Ltd. v. Quigg*, 894 F.2d 392, 395, 13 USPQ2d 1628, 1630 (Fed. Cir. 1990); *Hoechst Aktiengesellschaft v. Quigg*, 917 F.2d 522, 526, 16 USPQ2d 1549, 1552 (Fed. Cir. 1990).

Likewise, this Court should not defer to the PTO on the proper statutory construction of section 151. *See In re Portola Packaging Inc.*, 110 F.3d 786, 788, 42 USPQ2d 1295, 1298-99 (Fed. Cir. 1997) (rejecting PTO's interpretation of reexamination statute); *Ethicon v. Quigg*, 849 F. 2d 1422, 1425, 7 USPQ2d 1152, 1154 (Fed. Cir. 1988) ("[T]he courts are the final authorities on issues of statutory

construction."). Contrary to established Federal Circuit law, however, the district court improperly deferred to the PTO's interpretation under *Chevron U.S.A. Inc. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837 (1984). *BlackLight*, 109 F. Supp.2d at 48, 55 USPQ2d at 1815. (A9-10.) This Court has expressly held that the courts need not give *Chevron* deference to the PTO because the Commissioner does not have substantive rulemaking authority. *Merck & Co. v. Kessler*, 80 F.3d 1543, 1549-50, 38 USPQ2d 1347, 1351 (Fed. Cir. 1996).

Moreover, even under *Chevron* and its progeny, the courts do not defer to an agency's interpretation of a statute unless the relevant statute is silent or ambiguous on the question at hand. *Ad Hoc Comm. v. United States*, 13 F.3d 398, 402 (Fed. Cir. 1994); *see also Glaxo*, 894 F.2d at 398, 13 USPQ2d at 1633 (rule of deference in *Chevron* is limited to when statutory language has "left a gap" or is ambiguous). As explained below in Section V(B)(1), section 151 is clear and unambiguous on its face that the PTO must issue a patent after the applicant pays the issue fee.

Nor should this Court defer to the PTO simply because it has followed a practice of withdrawing patents from issue even after the issue fee has been paid for many years. *See In re Donaldson Co.*, 16 F.3d 1189, 1194, 29 USPQ2d 1845, 1849 (Fed. Cir. 1994) (*en banc*) (rejecting PTO's interpretation of 35 U.S.C. § 112, ¶ 6, despite its longstanding practice of not applying statute); *In re Recreative Techs. Corp.*, 83 F.3d 1394, 1397, 38 USPQ2d 1776, 1779 (Fed. Cir. 1996) (rejecting PTO's interpretation of reexamination statute despite its reliance on Manual of Patent Examining Procedure). "The fact that the PTO may have failed to adhere to a

statutory mandate over an extended period of time does not justify its continuing to do so." *Donaldson*, 16 F.3d at 1194, 29 USPQ2d at 1849.[3]

B. The PTO's Actions Violated the Plain Language of 35 U.S.C. § 151

The PTO is an administrative agency subject to judicial review under the Administrative Procedure Act (APA), 5 U.S.C. § 701, *et seq. Dickinson v. Zurko*, 527 U.S. 150, 152, 50 USPQ2d 1930, 1932 (1999). The APA authorizes the courts to "hold unlawful and set aside agency action" that is found to be "arbitrary, capricious, an abuse of discretion or otherwise not in accordance with law," or "in excess of statutory jurisdiction, authority, or limitations, or short of statutory right." 5 U.S.C. §§ 706(2)(A), 706(2)(C). Here, the PTO's actions in withdrawing BlackLight's patent applications from issue violated the express command in 35 U.S.C. § 151 that "the patent shall issue" upon payment of the issue fee.

1. Section 151 Unambiguously Commands Issuance of the Patent After Payment of the Issue Fee

The PTO's interpretation of 35 U.S.C. § 151, adopted by the district court, distorts the statute's plain meaning. Section 151 provides in pertinent part:

> If it appears that applicant is entitled to a patent under the law, a written notice of allowance of the application shall be given or mailed to the applicant. The notice shall specify a sum, constituting the issue fee or a

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[3] The Court may give weight to an agency's interpretation of a statute where some deference is due under *Chevron*. *See, e.g., Craft Machine Works, Inc. v. United States*, 926 F.2d 1110, 1114 (Fed. Cir. 1991) (granting deference under *Chevron* to Department of Defense's long-standing interpretation of regulation on cargo preference policies in military contracts). As discussed above, however, the courts need not give *Chevron* deference to the PTO. *Merck*, 80 F.3d at 1549-50. 38 USPQ2d at 1351.

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portion thereof, which shall be paid within three months thereafter.

Upon payment of this sum [i.e., the issue fee] *the patent shall issue*, but if payment is not timely made, the application shall be regarded as abandoned. (Emphasis added.)

Section 151 is unambiguous. As recognized by the district court, *BlackLight*, 109 F. Supp.2d at 47-48, 55 USPQ2d at 1815 (A8), the word "shall" is "the language of command." *Boyden v. Commissioner of Patents*, 441 F.2d 1041, 1043 n.3, 168 USPQ 680, 681 n.3 (D.C. Cir. 1970) (holding that 35 U.S.C. § 41, which provides that Commissioner "shall charge" various fees, does not give Commissioner any discretionary power to waive payment). It is used to impose an obligation to act. *See, e.g., International Union, UAW v. Dole*, 919 F.2d 753, 756 (D.C. Cir. 1990). Thus, section 151 unambiguously commands that the PTO must issue a patent after the applicant pays the issue fee.

The district court, however, agreed with the PTO that the introductory clause of section 151 ("If it appears that applicant is entitled to a patent under the law") somehow trumps the remainder of the statute. *BlackLight*, 109 F. Supp.2d at 48-49, 55 USPQ2d at 1816. (A10.) Like the PTO, the district court never explains how this introductory clause modifies the following paragraph in which the statutory command that a patent "shall issue" upon payment of the issue fee appears. The introductory clause merely provides that, in such event, "a written notice of allowance of the applicant shall be given or mailed to the applicant." It does not change the procedure after the PTO has sent the notice of allowance and the applicant has paid the issue fee, which is separately addressed in the second paragraph of section 151.

That is exactly the procedure that the PTO should have followed when it issued the notice of allowance in BlackLight's '294 application. In accordance with the first sentence of section 151, the PTO must have determined that BlackLight was "entitled to a patent under the law" when it issued the written notice of allowance. Then, in accordance with the second paragraph of section 151, after BlackLight paid the issue fee, the PTO had to issue the patent.[4]

In adopting the PTO's interpretation of section 151, the district court also declined to follow either *Sampson v. Dann*, 466 F. Supp. 965, 201 USPQ 15 (D.D.C. 1978), or *Brenner v. Ebbert*, 398 F.2d 762, 157 USPQ 609 (D.C. Cir. 1968). In *Brenner*, the court pointed out that, under the statutory framework, examination of a patent application is complete when the application is allowed. "Congress established a separate statutory framework for what remains—issuance of the patent. It is a relatively ministerial act; if the issue fee is timely tendered, the patent must

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[4] Similarly, 35 U.S.C. § 131, which deals with examination of patent applications, does not override the plain language of section 151. Section 131 states generally that a patent shall issue "if on such examination it appears that the applicant is entitled to a patent under the law." Section 151, on the other hand, which deals more particularly with issuance, mandates the procedure that the PTO must follow once an applicant is entitled to a patent, including a written notice of allowance and issuance of the patent after payment of the issue fee. Section 131's general command to issue a patent if it appears that the applicant is entitled to one does not give the PTO authority to ignore other, more specific commands, once it determines that the applicant is entitled to a patent.

issue." *Id.* at 764, 157 USPQ at 611.[5] *See also United States Gypsum Co. v. Masonite Corp.*, 21 F. Supp. 551, 552, 36 USPQ 22, 23 (D. Del. 1937) (stating that, "[u]pon the payment of the final fee the Commissioner is bound by statute to issue the patent").

Brenner was followed in *Sampson*, 466 F. Supp. 965, 201 USPQ 15, which the district court admitted is factually analogous to the present case. *BlackLight*, 109 F. Supp.2d at 51, 55 USPQ2d at 1817. (A16.) After Sampson received a notice of allowance and paid the fee in a reissue application, a defendant in a patent infringement action brought by Sampson wrote the Patent Office to call to the examiner's attention additional prior art. *Sampson*, 466 F. Supp. at 969, 201 USPQ at 18-19. The Patent Office withdrew the application, and, over Sampson's protest, rejected the application over the new prior art. The district court held that the command in section 151 that "'the patent shall issue' created an enforceable right" in Sampson, and directed the Patent Office to issue the patent. *Id.* at 972, 201 USPQ at 21.

Instead of following *Sampson*, the district court chose to follow *Harley v. Lehman*, 981 F. Supp. 9, 44 USPQ2d 1699 (D.D.C. 1997). *BlackLight*, 109 F. Supp.2d at 52, 55 USPQ at 1818-19. (A20.) The court in *Harley*, however, simply deferred to the PTO under *Chevron*, finding that the PTO's interpretation of section 151 allowing patents to be withdrawn from issue was "not unreasonable." 981 F.

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[5] Although the statements in *Brenner* can be characterized as dicta, the district court recognized that *Brenner* concluded that Congress had created separate statutory frameworks for the examination and issuance of patents. *BlackLight*, 109 F. Supp.2d at 50, 55 USPQ2d at 1817. (A15-16.) The PTO's interpretation of section 151, adopted by the district court, however, fails to recognize this distinction, and would continue the examination stage into the separate stage for issuance of patents, inconsistent with the reasoning in *Brenner*.

Supp. at 12, 44 USPQ2d at 1702. As explained in Section V(A) above, the PTO is not entitled to such deference because the Commissioner does not have substantive rulemaking authority. *Merck*, 80 F.3d at 1549-50, 38 USPQ2d at 1351. Moreover, even under *Chevron*, the courts should not defer to the PTO's interpretation because the statute is unambiguous. *See Glaxo*, 894 F.2d at 398, 13 USPQ2d at 1630. Consequently, *Harley* is unpersuasive and should not be followed.[6]

The district court also chose to follow *Harley* based on the false distinction that *Sampson* was decided before the PTO adopted the regulation in 37 C.F.R. § 1.313(b) allowing it to withdraw applications from issue on grounds of unpatentability. *BlackLight*, 109 F. Supp.2d at 52, 55 USPQ2d at 1819. (A19-20.) *See also Harley*, 981 F. Supp. at 12 n.3, 44 USPQ2d at 1702 n.3. Earlier in the district court's opinion, however, it recognized that the PTO previously withdrew patent applications from issue on grounds of "mistake," which included reasons related to unpatentability. *BlackLight*, 109 F. Supp.2d at 49, 55 USPQ2d at 1816 (*citing Hull v. Commissioner*, 8 D.C. (2 MacArth.) 90 (1875)). (A12.) The 1982 addition of the "unpatentability" exception had no substantive effect on the regulation. Therefore, the fact that the

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[6] Like the appealed decision, the D.C. district court's decision in *Harley* is not binding on this Court.

Harley court squarely considered section 1.313(b), *id.* at 52, 55 USPQ2d at 1819 (A20), does not make *Harley* more persuasive.[7]

It is undisputed that BlackLight paid the issue fee for its patent applications. The Notice of Allowance in the '294 application stated: "<u>PROSECUTION ON THE MERITS IS CLOSED</u>." (A135.) All that remained after BlackLight paid the issue fees were the ministerial steps of preparing and publishing the applications as patents. Under the plain language of section 151, the PTO must issue the patents.

2. The Legislative History Is Consistent With Section 151's Plain Language

Neither the PTO nor the district court cited anything in the legislative history of section 151 that would justify their interpretation contrary to the statute's plain language. "When statutory interpretation is at issue, the plain and unambiguous meaning of a statute prevails in the absence of clearly expressed legislative intent to the contrary." *Donaldson*, 16 F.3d at 1192-93, 29 UPSQ2d at 1848; *Glaxo*, 894 F.2d at 395, 13 USPQ2d at 1630 ("When . . . the terms of a statute [are] unambiguous, judicial inquiry is complete, except in rare and exceptional circumstances."). Here, the legislative history does not contradict its plain language; rather, it confirms that Congress intended to speed up the issuance of patents.

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[7] The district court also found that *Harley* is "factually and procedurally identical to the present case." *BlackLight*, 109 F. Supp.2d at 51, 55 USPQ2d at 1818. (A18.) As explained further below in Section V(C), in *Harley*, unlike this case, a PTO director made an actual determination of unpatentability based on new prior art submitted in a protest, before withdrawing the application from issue. (A596-97 n.10.) In this case, there was never any new prior art, and there was never a determination of unpatentability before the PTO withdrew the '294 application from issue.

Section 151 derives from R.S. § 4885, which as enacted in 1870 provided "That every patent shall date as of a day not later than six months from the time at which it was passed and allowed, and notice thereof was sent to the applicant or his agent; and if the final fee shall not be paid within that period, the patent shall be withheld." Act of July 8, 1870, ch. 230, § 23, 16 Stat. 201 (1870). (See A162.) In 1908, Congress amended section 4885 to provide:

> Every patent shall issue within a period of three months from the date of payment of the final fee, which fee shall be paid not later than six months from the time at which the application was passed and allowed and notice thereof was sent to applicant or his agent; and if the final fee is not paid within that period the patent shall be withheld.

Act of May 23, 1908, ch. 189, 35 Stat. 246 (1908) (A161.)

The House Report explained that the amendment to section 4885 was intended to address the problem caused by applicants waiting until the end of the six-month period to pay the issue fee. (A162-63.) When an applicant waited until the end of the six-month period, the Patent Office could not print and prepare the patent for issuance so that it could bear a date "not later than six months from the time" of allowance. (*Id.*) In order to meet the statutory deadline, the practice arose that the Patent Office would issue a second notice of allowance. (A163.) Congress solved this problem by making the payment of the issue fee the trigger for determining when the patent must issue. It did not give the Patent Office any discretion to withdraw the patent once the issue fee was paid.

Section 4885 was recodified as 35 U.S.C. § 41. (See A164.) In 1939, this section was amended to give the Commissioner discretion to "receive the final fee if paid within one year after the six months' period for payment has passed and the patent shall issue." Act of August 9. 1939, § 2. 53 Stat. 1293 (1939). (A164.) Again,

once payment was made, the Patent Office was constrained to follow the statutory command and issue the patent.

In 1953, 35 U.S.C. § 41 was recodified with no substantive change as 35 U.S.C. § 151. In 1965, section 151 was amended to decrease the time period for payment of the issue fee from six months to three months and to decrease the grace period for late payment from one year to three months. *See Brenner*, 398 F.2d at 764, 157 USPQ at 611. The purpose of this amendment was "to expedite the prosecution of patent applications and thus make new technology available to the public at an earlier date." *Id., quoting* S. Rep. No. 301, 89th Cong., 1st Sess 1 (1965), U.S. Code Cong. & Admin. News 1965, pp. 2315, 2316.

Thus, the legislative history shows that, since 1908, Congress has mandated that a patent shall issue once the issue fee is paid, consistent with its intention to expedite, not delay, the issuance of patents. There is nothing in the legislative history showing a contrary intention necessary to override section 151's plain language.

3. The PTO's Regulation Is Invalid

The PTO purportedly withdrew the '294 application from issue pursuant to 37 C.F.R. § 1.313(b)(3), which provides that, after the applicant has paid the issue fee, the application will not be withdrawn from issue for any reason except the "[u]npatentability of one or more claims." Section 1.313(b), however, is inconsistent with the statutory mandate in section 151 that a patent *shall* issue after payment of the issue fee. Therefore, this Court should reject section 1.313(b) as contrary to the statutory language.

The PTO does not have substantive rulemaking powers. *Merck*, 80 F.3d at 1549-50, 38 USPQ2d at 1351. 35 U.S.C. § 6 authorizes the Commissioner to "establish regulations, not inconsistent with law, for the conduct of proceedings" in

the PTO. Thus, section 1.313(b) does not have the force and effect of law, and the courts do not owe deference to the regulation as they would if the PTO had substantive rulemaking powers. *See Merck*, 80 F.3d at 1549, 38 USPQ2d at 1351. Contrary to this precedent, however, the district court upheld the regulation by improperly deferring to the PTO under *Chevron.* 109 F. Supp.2d at 50, 55 USPQ2d at 1817. (A14.) Ultimately, "the courts are the final authorities on issues of statutory construction. They must reject administrative constructions . . . , whether reached by adjudication or by rulemaking, that are inconsistent with the statutory mandate or that frustrate the policy that Congress sought to implement." *FEC v. Democratic Senatorial Campaign Comm.*, 454 U.S. 27, 32 (1981).

The PTO tries to justify its regulation allowing it to withdraw applications after the applicant has paid the issue fee on the ground that it has an obligation to issue patents that meet the statutory requirements for patentability. (A152.) *See also BlackLight*, 109 F. Supp.2d at 49-50, 55 USPQ2d at 1816-17. (A12; A14.) In an analogous situation, however, this Court rejected the PTO's argument that it could reexamine patent claims on grounds previously considered, even though such a reexamination might show that the requirements for patentability had not been met. *See In re Recreative Techs. Corp.*, 83 F.3d 1394, 1397, 38 USPQ2d 1776, 1779 (Fed. Cir. 1996). The reexamination statute, 35 U.S.C. § 303, allows reexamination of a patent only if there is a "substantial new question of patentability." Rejecting the PTO's reliance on the Manual of Patent Examining Procedure (MPEP), which at the time allowed reexamination on grounds previously considered, the Federal Circuit held that the "power [to reexamine questions of patentability decided in original examination] can not be acquired by internal rule of procedure or practice. The

policy balance reflected in the reexamination statute's provisions can not be unilaterally realigned by the agency." *Id.* at 1398, 38 USPQ2d at 1779.

Likewise, the PTO cannot by regulation or otherwise withdraw applications from issue after the issue fee has been paid in violation of section 151. The PTO's regulation in section 1.313(b) is contrary to the statutory mandate that a "patent shall issue" upon timely payment of the issue fee and is therefore invalid.

C.   The PTO Did Not Follow Its Own Regulation

Even assuming that 35 U.S.C. § 151 does not prohibit the PTO from withdrawing an application from issue after payment of the issue fee, the PTO still failed to follow its own regulation. As noted above, the PTO purportedly withdrew the '294 application from issue pursuant to 37 C.F.R. § 1.313(b)(3), which provides that, after the applicant has paid the issue fee, the application will not be withdrawn from issue for any reason except the "[u]npatentability of one or more claims." There is nothing in the administrative record, however, which shows that Ms. Kepplinger or anyone else ever determined that the claims of the '294 patent are unpatentable. It is undisputed that Ms. Kepplinger never reviewed the contents of the application before the Notice issued on February 17, 2000, because the file could not be located. (A3-4; A40; A53; A131; A551.) Nearly two weeks later on February 28, 2000, she still did not have the '294 application file. (A133.) Mr. Spar admitted that he did not review the '294 application either. (A132; A555.) He mistakenly thought that the application was directed to "cold fusion." (A51; A131; A555.)

Even the PTO's decision issued March 22, 2000, implicitly acknowledged that there had been no determination of the unpatentability of the '294 claims, only that "[a]n Office Action addressing the merits of the application *or* a supplemental Notice of Allowance will issue in due course." (A153; emphasis added.) Although the

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March 22 decision states that the withdrawal was "due to the Director's determination that one or more claims lacked patentability" (A150), that clearly was not true since neither Ms. Kepplinger nor Mr. Spar saw the file before withdrawing the '294 application from issue.

Without a determination of unpatentability, section 1.313(b)(3) does not authorize the PTO to withdraw an application from issue. The district court, however, erroneously rejected BlackLight's argument that this regulation, even if valid in light of section 151, requires the PTO to have made at least an actual determination of unpatentability as a prerequisite to withdrawing an application. *BlackLight*, 109 F. Supp.2d at 54, 55 USPQ2d at 1820. (A25.) Instead, the court agreed with the PTO that it could withdraw an application based merely on the "possibility of unpatentability" (*id.*), since there was never a determination that any of the claims of the '294 application is unpatentable.

The district court's strained reading of the regulation to excuse the PTO's arbitrary action in this case cannot stand. To allow the PTO to withdraw an application from issue based on the mere "possibility" of unpatentability would make both the notice of allowance and the regulation prohibiting withdrawal after the issue fee has been paid except in specifically defined circumstances meaningless. The PTO could withdraw an application based on a whim, or, as it did here, based on hearsay information received from outside the PTO without even reviewing the file. What's more, a competitor who becomes aware of a patent that is about to issue could go directly to the PTO and try to convince the examiner to withdraw the patent from issuance based on little or no evidence.

Again, the district court's reliance on *Harley* is misplaced. In *Harley*, the plaintiff argued that the examiner, not the Group Director, should have made the

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prerequisite determination of unpatentability as the basis for withdrawing the application from issue. In response, the PTO argued that the prerequisite determination of unpatentability was properly made by the Group Director, and thus satisfied the requirements of section 1.313(b)(3). (A596-97 n.10.) That clearly was not done here, as Ms. Kepplinger admitted she did not even have the file when she made the decision to withdraw the '294 application from issue.[8]

Even if this Court were to follow *Harley*, it should require that the PTO had to have made an actual determination of unpatentability as it argued was necessary in that case. The inconsistency between the PTO's positions in *Harley* and here, as well as the plain language of section 1.313(b)(3), compels reversal of the PTO's actions in this case.

D.   The PTO's Actions Were Arbitrary and Capricious

The district court never squarely addressed BlackLight's contention that, even if a determination of unpatentability is not required to withdraw an application from issue pursuant to section 1.313(b)(3), the PTO's actions in this case were still arbitrary and capricious. The court noted that it was troubled by several steps in the PTO's process, including withdrawing the '294 application from issue "without the benefit of any PTO employee's re-evaluating the file." *BlackLight*, 109 F. Supp. at 54 n.10, 55 USPQ2d at 1820 n.10. (A25 n.10.) The district court's concern should have led it to the conclusion that the process was arbitrary and capricious, a conclusion that this Court should reach on appeal.

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[8] Compare the Notice issued in *Harley*, which stated that "[t]he application is being withdrawn to apply a new rejection based on new art submitted in a protest" (A600), with the February 17 Notice in this case, which merely states that "[t]he application is being withdrawn to permit reopening of prosecution" (A48).

Specifically, the PTO's decision to withdraw BlackLight's '294 application was arbitrary and capricious because no one reviewed the relevant facts and there is no rational connection between the facts actually relied on by the PTO and the decision to withdraw the application. *See Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) (holding that agency must examine relevant data and articulate "rational connection between the facts found and the choices made"). Neither Ms. Kepplinger nor Mr. Spar reviewed the '294 application file before it was withdrawn; therefore, neither one could have independently considered the patentability of any of the claims. Indeed, the PTO has conceded that the decision to withdraw the application was prompted by an outside inquiry from a reporter. (A808 n.12; A853 n.10; see A810-12.)

According to the PTO's March 22 decision, Ms. Kepplinger became aware of the '935 patent, which had already issued, and questioned whether it was based on known scientific principles. (A147.) She then decided to withdraw the '294 application without even knowing what the application disclosed, the scope of the allowed claims as compared to the '935 patent, or whether the same issues had already been raised during prosecution before the examiner. In fact, their titles alone indicate that the '935 patent and the '294 application are directed to different subject matter: the '935 patent relates to "Lower-Energy Hydrogen Methods and Structures," and the '294 application relates to "Hydride Compounds." Moreover, the examiner who examined the '294 application had already raised issues related to operability of the technology (A129; A398-401), and had considered experimental evidence presented by the applicants positively identifying the new compositions of matter. (A51; A129; A520; see A467-68; A471-72.) At the time she decided to withdraw the application from issue. however. Ms. Keppli: er could not have possibly known any

of this because she had only looked at the '935 patent, a patent that was presumed to be valid.
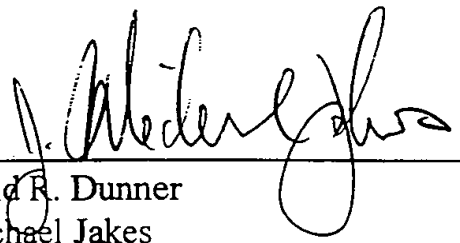
Therefore, since the PTO's decision to withdraw the '294 application from issue was not based on a review of the relevant facts, but only on a presumably valid issued patent, the decision was arbitrary and capricious. It should be set aside on that basis.

VI. CONCLUSION AND STATEMENT OF RELIEF SOUGHT

For these reasons, the district court's grant of summary judgment for the Commissioner and against BlackLight should be reversed. The case should be remanded to the district court with instructions to set aside the PTO's illegal actions in withdrawing BlackLight's application Serial Nos. 09/009,294, 09/008,947, 09/009,455, 09/009,678, and 09/111,160, and to direct that these applications issue as patents.

Respectfully submitted,

Dated: November 6, 2000

By:_____

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ADDENDUM

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                              )
BLACKLIGHT POWER, INC.        )
                              )
            Plaintiff,        )
                              )
        v.                    )    Civil Action No. 00-422 (EGS)
                              )    [11-1][13-1]
                              )
Q. TODD DICKINSON,            )
Commissioner of Patents.      )
and Trademarks,               )                      FILED
                              )
            Defendant.        )                   AUG 15 2000
                              )
```

NANCY MAYER WHITTINGTON, CLERK
U.S. DISTRICT COURT

MEMORANDUM OPINION AND ORDER

I.   Introduction

Plaintiff Blacklight Power, Inc., alleges that defendant Q.
Todd Dickinson, Commissioner of the Patent and Trademark Office
(PTO), violated the Administrative Procedure Act (APA), 5 U.S.C.
§ 706 et seq., when the PTO withdrew one and threatened to
withdraw four others of plaintiff's patents from issue after
plaintiff had received a "Notice of Allowance and Issue Fee Due"
and payed the issue fee. The issues presented are whether the
defendant had the authority to withdraw plaintiff's patent after
plaintiff had paid the issue fee, and, if defendant did have the
authority, whether that withdrawal was arbitrary and capricious.
Plaintiff claims that defendant's actions were arbitrary and
capricious, and that the internal regulation on which defendant
relies contravenes the governing patent statute. Pending before

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the Court are the parties' cross motions for summary judgment. Upon consideration of the parties' motions, memoranda in support, responses in opposition, replies in support, and the arguments at the May 22, 2000 motions hearing, plaintiff's motion for summary judgment [11-1] is **DENIED**, and defendant's motion for summary judgment [13-1] is **GRANTED**.

II. Factual Background

Plaintiff has filed a series of five patent applications for technology that, according to plaintiff, represents a new source of chemical energy from hydrogen. One of these, titled "Lower-Energy Hydrogen Methods and Structure," was filed March 21, 1997. This application was issued as U.S. Patent No. 6,024,935 (the '935 patent) on February 15, 2000. Another of these, Ser. No. 09/009,294 (the '294 application), titled "Hydride Ions," had been filed January 20, 1998. During prosecution of the '294 application, plaintiff cited over 130 prior art articles concerning "cold fusion" and "perpetual motion." When the primary patent examiner raised issues relating to the operability of the '294 technology, plaintiff conducted a personal interview with the examiner to discuss the articles and the operability issues. On October 18, 1999, defendant issued a Notice of Allowance and Issue Fee Due for the '294 application (Notice). The Notice reads:

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THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.

THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE . . . Pl.'s Mot. for Summ. J., Ex. 2.

Plaintiff paid the issue fee three days later, October 21, 1999. *See* Pl.'s Mot. for Summ. J., Ex. 3. Following payment of the issue fee, the '294 application was set to issue as U.S. Patent No. 6,030,601 on February 29, 2000.

On February 17, 2000, twelve days before the '294 application was to issue, Frances Hicks, a Petitions Examiner with the Office of Petitions, Office of the Deputy Assistant Commissioner for Patent Policy Projects, issued a Notice (February 17 Notice) informing plaintiff that, by request of the Director of the Special Program Law Office, "the ['294] application . . . is being withdrawn from issue pursuant to 37 C.F.R. § 1.313 . . . to permit reopening of prosecution." Pl.'s Mot. for Summ. J., Ex. 4. It is uncontested that the '294 application file was not in defendant's possession at the time this Notice was sent.

Upon receiving the February 17 Notice, plaintiff's patent counsel began investigating the circumstances surrounding the withdrawal, contacting different PTO employees by telephone and by mail, including Ms. Hicks, and Director Esther Kepplinger. On February 28, 2000, plaintiff's patent counsel hand-delivered a

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final letter asking that the withdrawal be reconsidered. Director

Kepplinger met with him to receive the letter. She conceded that

she still did not have a copy of the '294 application, at which

time plaintiff's patent counsel provided her with a copy of his

own '294 application file. See Pl.'s Mot. for Summ. J. at 10;

Melcher Decl. ¶ 22. In that meeting, Director Kepplinger

indicated that she was concerned that the '294 technology

involved "cold fusion" and "perpetual motion."[1] She also stated

that the PTO intended to withdraw from issue four others of

plaintiff's patents-in-application.[2] See Verified Compl. ¶ 22.

Pursuant to 37 C.F.R. § 1.181(a)(3), defendant treated

plaintiff's February 28 letters to the Commissioner, Director

Robert Spar, and Director Kepplinger, as a single petition

requesting that the Commissioner exercise his supervisory

authority and reverse the PTO's withdrawal decision. In a

decision issued March 22, 2000 (March 22 Decision), defendant

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[1]   In plaintiff's motion for summary judgment, plaintiff
details that Director Kepplinger indicated that Commissioner
Dickinson had telephoned her and told her to re-evaluate the '294
application after receiving communications from undisclosed
third-party sources complaining about the '935 patent. See Pl.'s
Mot. for Summ. J. at 11. However, at the May 22, 2000 motions
hearing, for the purposes of the summary judgment motion,
plaintiff's counsel retracted its argument that the withdrawal of
the '294 application was in response to pressure outside of the
PTO. See May 22, 2000 Hr'g. Tr. at 52.

[2]   The four other patent applications are: Ser. No.
09/008,947, filed January 20, 2998; Ser. No. 09/009,455, filed
January 20, 1998; Ser. No. 09/009,678, filed July 7, 1998; and
Ser. No. 09/111,160, filed July 7, 1998.

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denied plaintiff's petition, refused to rescind the February 17

Notice, and disallowed plaintiff's patent. *See* Pl.'s Mot. for

Summ. J., Ex. 8. The March 22 Decision indicated that the reason

behind the withdrawal of the '294 application was its similarity

to the '935 patent, both of which claimed to attain energy levels

below the ground state according to a "novel atomic model." *See*

Pl.'s Mot. for Summ. J., Ex. 8 at 2. Both claim that the

electron of a hydrogen atom can attain an energy level and orbit

below the 'ground state' corresponding to a fractional quantum

number. According to defendant, this assertion alarmed the

Director, who had examined the '935 patent, and who had learned

of the '292 application, because it "did not conform to the known

laws of physics and chemistry." *Id.* The March 22 Decision

states that the Director "was immediately aware that any pending

application embodying such a concept raise[d] a substantial

question of patentability of one or more claims which would

require reopening prosecution." *Id.*

III. Procedure

Plaintiff filed this lawsuit on March 1, 2000. Plaintiff's

complaint consists of two counts. Count I seeks preliminary and

permanent injunctive relief directing defendant to issue the five

contested patents-in-application as patents. Count II seeks a

declaratory judgment that defendant's withdrawal of the patent

applications was arbitrary and capricious and contrary to the PTO's own regulations and to the applicable patent issue statute. Plaintiff filed its motion for a temporary restraining order and preliminary injunction on March 2, 2000. At their March 3, 2000 hearing, the parties agreed that plaintiff would withdraw its motion without prejudice, and defendant would not take any Office Action with respect to the patents-in-application. On March 8, 2000, the Court issued an order memorializing that agreement, and setting a briefing schedule. Defendant filed the administrative record on March 22, 2000. The parties filed their cross motions for summary judgment on April 4, 2000. They filed their responses in opposition on April 18, 2000. Plaintiff filed its reply in support on May 1, 200C, and defendant filed its reply in support on May 5, 2000. The Court held a motions hearing on the cross motions for summary judgment on May 22, 2000.

IV. Discussion

The Court must examine several questions to resolve the pending cross motions. First, the Court must determine whether defendant has the authority to withdraw plaintiff's patent after plaintiff has paid the issue fee. If the Court determines that the PTO did possess the requisite authority, then the Court must conclude which PTO issuance, the February 17 Notice or the March 22, 2000 Decision, constitutes final, reviewable agency action.

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As the last step, the Court must determine whether that final

agency action was arbitrary and capricious in contravention of

the APA.

A.   Whether the PTO Has the Authority To Withdraw
      Plaintiff's Patent After Payment of the Issue Fee

Plaintiff argues that the PTO does not have the authority to

withdraw plaintiff's patent after payment of the issue fee for

three reasons: 1) because doing so violates the plain language of

the statute, 2) because the PTO regulation on which defendant

bases its authority violates the plain language of the statute,

and 3) because case law directs defendant to issue the patent

upon payment of the fee.

1.   *Patent Issuance Statute: 35 U.S.C. § 151*

The parties interpret 35 U.S.C. § 151, the statute governing

the issuance of patents, to support their respective positions by

focusing on different sections of the statute.   35 U.S.C. § 151

provides in relevant part:

> **If it appears that applicant is entitled to a
> patent under the law,** a written notice of allowance of
> the application shall be given or mailed to the
> applicant.   The notice shall specify a sum,
> constituting the issue fee or a portion thereof, which
> shall be paid within three months thereafter.
> *Upon payment of this sum the patent shall issue,*
> but if payment is not timely made, the application
> shall be regarded as abandoned. 35 U.S.C. § 151
> (emphases added).

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Plaintiff focuses on the italicized language directing that "[u]pon payment of [the issue fee] the patent shall issue." It is well-established that "shall" is the "language of command." *Boyden v. Commissioner of Patents*, 441 F.2d 1041, 1042 n.3 (D.C. Cir. 1970), *cert. den.*, 404 U.S. 842 (1971). Here, it is uncontroverted that the Notice of Allowance for the '294 application stated that the application was "allowed for issuance as a patent" and that "prosecution on the merits is closed." Pl.'s Mot. for Summ. J., Ex. 2. It is also uncontroverted that plaintiff paid the appropriate fees. Accordingly, plaintiff contends that defendant's defalcation is at loggerheads with the statute's clear command.

Defendant argues that if the statute is read *in toto*, *see Dole v. United Steelworkers of Am.*, 494 U.S. 26, 35 (1990), it is clear that the withdrawal of these patent applications is within the PTO's power. Defendant notes that the entire section is premised on whether "it appears that [the] applicant is entitled to a patent under the law." Here, defendant contends, that is not so, because of plaintiff's claims of having attained an energy level and orbit below the hydrogen "ground state" corresponding to a fractional quantum number. Defendant also reminds the Court that even though the word "shall" generally is interpreted as imposing a mandatory duty, "shall" may also be interpreted differently depending on its context. *See LO*

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Shippers Action Committee v. ICC, 857 F.2d 802, 806 (D.C. Cir. 1988). As a result, defendant contends, plaintiff's textual argument is not persuasive.

The parties clash over the appropriate standard of review for the PTO's interpretation of 35 U.S.C. § 151. Plaintiff contends that, since the language of 35 U.S.C. § 151, the patent issuance statute, is unambiguous, the proper statutory construction of § 151 is a question of law that the court decides without deference to the PTO's interpretation. In *In re Portola Packaging Inc.,* 110 F.3d 786, 788 (Fed. Cir. 1977), the court held that judicial inquiry is "complete" when the terms of a statute are unambiguous. Plaintiff argues that § 151 is unambiguous because it dictates that the "patent shall issue" upon payment of the issue fee.

Defendant responds that the PTO's interpretation of 35 U.S.C. § 151 is due *Chevron* deference, and should be upheld. *See Chevron U.S.A., Inc. v. Natural Resources Defense Council, Inc.,* 467 U.S. 837, 842-44 (1984). "When faced with a problem of statutory construction, [the reviewing court should] show[] great deference to the interpretation given the statute by the officers or agency charged with its administration." *Udall v. Tallman,* 380 U.S. 1, 16 (1965). The PTO Director is charged with administering 35 U.S.C. § 151. Accordingly, defendant maintains, the Court should grant defendant's interpretation considerable

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deference. For additional support, defendant cites *Harley v. Lehman*, 981 F.Supp. 9 (D.D.C. 1997). The *Harley* court held that the PTO's interpretation of § 151 is due *Chevron* deference, and that the PTO's interpretation was reasonable in light of the agency's "duty to ensure that the patents it issues are valid." *Id.* at 11. The Court is persuaded that the holding of the *Harley* court, which applied to a situation factually and procedurally identical to the present case, applies to the present case.[3] Therefore, the Court will accord the PTO's interpretation of 35 U.S.C. § 151 the deference it is due under *Chevron*.

Examining the parties' interpretations under the by now familiar *Chevron* two-step inquiry, this Court concludes that defendant's interpretation of the plain language 35 U.S.C. § 151 should be upheld. *See Harley*, 981 F.Supp. at 11. The code premises issuance of a patent upon payment of the issue fee "[i]f it appears that applicant is entitled to a patent under the law. . . ." *See* 35 U.S.C. § 151. These words clearly establish the PTO's mandate to issue valid patents. *See In re Etter*, 756 F.2d 852 (Fed. Cir. 1985).

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[3]   For a more in-depth discussion of Harley, see A.3., "Caselaw."

2. *PTO's Administrative Regulation: 37 C.F.R. §
1.313(b)*

Plaintiff asseverates that 37 C.F.R. § 1.313(b), the PTO

regulation implementing § 151, on which the PTO based withdrawal

of the '294 application and its proposed withdrawal of the other

four allowed applications, is invalid. Plaintiff contends that

that regulation violates § 151's mandate that patents shall issue

upon payment of the issue fee. 37 C.F.R. § 1.313(b) provides:

> When the issue fee has been paid, the application will
> not be withdrawn from issue for any reasons except:
> (1) a mistake on the part of the Office;
> (2) a violation of § 1.56 [fraud] or illegality in
> the application;
> (3) *unpatentability of one or more claims* . . .
> 37 C.F.R. § 1.313(b) (emphasis added).

The gravamen of plaintiff's regulatory argument is that the issue

before the Court is not whether the PTO is obligated to determine

a claim's patentability, but when it must make this

determination. Plaintiff argues that § 151 and its legislative

history indicate that the PTO must make this determination before

issuance of the notice of allowance and payment of the issue

fee.[4]

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[4]   Plaintiff compares § 151 to 35 U.S.C. § 303, the patent
reexamination statute, which allows reexamination of a patent
only if there is a "substantial new question of patentability."
The Federal Circuit, dismissing the PTO's reliance on its Manual
of Patent Examining Procedure (MPEP), held that this statute does
not allow reexamination of patent claims on ground considered
before the patent was issued, even though reexamination might
reveal that the requirements for patentability had not been met.

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Defendant counters that the PTO has long had the discretion
to withdraw a patent even after payment of the issue fee on
unpatentability grounds. Subsection (3) was added to 37 C.F.R. §
1.313(b) in 1982. However, even before the addition of the
"unpatentability" language, the PTO had the discretion to
withdraw applications from issue on the basis of "mistake on the
part of the Office" or subsection (1). The mistake ground was
consistently held to envelop subsequently discovered reasons
undermining an application's patentability. *See, e.g., Hull v.
Commissioner of Patents*, 8 D.C. (2 MacArth.) 90 (1875)(denying
writ of mandamus requesting issue of withdrawn patent). Indeed,
defendant argues that the Director has not only the discretion
but the duty to withdraw a patent from issue if there is a
question about its patentability. *See In re Alappat*, 33 F.3d
1526, 1535 (Fed. Cir. 1994)(en banc)(plurality opinion)(holding
that the "Commissioner has an obligation to refuse to grant a
patent if he believes that doing so would be contrary to law").

As for the standard of review of the PTO's adoption of 37
C.F.R. § 1.313(b), its own regulation, plaintiff offers two
arguments to support its contention that the Court's review
should be more searching and less deferential. First, plaintiff
argues that 37 C.F.R. § 1.313(b) does not have the force and

In re Recreative Technologies Corp., 83 F.3d 1394, 1397 (Fed.
Cir. 1996).

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effect of law, because the PTO does not have substantive

rulemaking powers outside of its own regulations,[5] and so the

regulations are not entitled to the Court's deference.

Alternatively, plaintiff avers that, even if the Court were

persuaded that deference is owed § 1.313(b) because it concerns

patent proceedings, the regulation still cannot be "inconsistent

with law," and under this standard, § 1.313(b) is invalid. Even

where an agency's interpretation is entitled to deference, "the

courts are the final authority on the issue of statutory

construction. They must reject administrative constructions,

whether reached by adjudication or by rulemaking, that are

inconsistent with the statutory mandate or that frustrate the

policy Congress sought to implement." *FEC v. Democratic

Senatorial Campaign Comm.*, 454 U.S. 27, 32 (1981). Here,

plaintiff claims, Congress has explicitly spoken to the salient

issue, and so the court "must give effect to the unambiguously

expressed intent of Congress." *Brown & Williamson Tobacco Corp.*,

2000 WL 289576 at *6.

Defendant maintains that *Chevron* deference is appropriate

here as well, on several grounds. First, as noted above,

defendant argues that this regulation is due great deference

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[5]   35 U.S.C. § 6 empowers the Commission to "establish
regulations, not inconsistent with law, for the conduct of
proceedings in the Office." Accordingly, the Commissioner may
issue only those regulations concerning the conduct of PTO
proceedings.

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because it was propounded pursuant to a statute that the PTO Director is charged with administering. *See Udall v. Tallman*, 380 U.S. 1, 16 (1965). Second, defendant argues that the Court must "accord[] considerable weight to the prior long-standing interpretation, if reasonable, of the agency charged with administering a regulatory scheme," *see Craft Machine Works, Inc. v. United States*, 926 F.2d 1110, 1114 (Fed. Cir. 1991), and that 35 U.S.C. § 151 and 37 C.F.R. § 1.313(b) have co-existed without incident under that "prior long-standing interpretation."[6]

This Court is persuaded by defendant's argument. According the PTO's adoption of 37 C.F.R. § 1.313(b) appropriate deference under *Chevron*, this Court holds that the PTO's regulation is eminently reasonable, in light of the PTO's purpose of issuing valid patents, and contravenes neither the spirit nor the letter of 35 U.S.C. § 151.

3. *Caselaw and Intersection between 35 U.S.C. § 151 and 37 C.F.R. § 1.313(b)*

Plaintiff cites three cases in support of its argument that, once patent fees have been paid, issuance of the patent is a

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[6] The PTO has interpreted the "shall issue" language as allowing the withdrawal of a patent after payment of the issue fee for almost a century. *See* Rules of Practice in the Patent Office § 165-55 (1888-1848); Rules of Practice of the United States Patent Office in Patent Cases § 313 (1949-1972); *and see* 37 C.F.R. § 1.313(b) (1973-1996).

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required administrative formality.[7] In *Brenner v. Ebbert*, 398

F.2d 762 (D.C. Cir. 1968), *cert. den.*, 393 U.S. 926 (1968), the

D.C. Circuit stated that "if the issue fee is timely tendered,

the patent must issue," and that issuance of the patent is "a

relatively ministerial act." *Brenner*, 398 F.2d at 764. The

Brenner plaintiffs failed to pay the issue fee within the

statutory three month time period because of an error by their

attorney. When plaintiffs tried to pay the fee almost seven

months after it was due, defendant PTO rejected the payment.

Plaintiffs tried to revive the application. The Commissioner

dismissed the petition. Plaintiffs brought suit to reverse the

dismissal, compel revival, acceptance of the fee, and issuance of

the patent. *Id.* at 763. The court upheld the PTO's dismissal.

Defendant notes that, since *Brenner* concerned the timing of

payment of the issue fee, and not the PTO's authority to withdraw

a patent from issue, the language on which plaintiff relies is

dicta. Defendant is correct. In fact, the court expressly set

aside meaningful consideration of the patent issuance language,

preceding the language on which plaintiff relies with "[c]ongress

established a separate statutory framework for what remains --

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[7]   Plaintiff also cites Judge Newman's concurring opinion
in *Exxon Chem. Patents, Inc. v. Lubrizol Corp.*, 935 F.2d 1263
(Fed. Cir. 1991), as persuasive authority in support. Defendant
notes that this was only a concurrence, and therefore "not the
law," as Judge Newman herself pointed out in *Pioneer Hi-Bred
Int'l, Inc. v. J.E.M. Ag Supply, Inc.*, 200 F.3d 1374, 1378 (Fed.
Cir. 2000).

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issuance of the patent." Accordingly, the Court is not persuaded by this language.

Plaintiff also cites *United States Gypsum Co. v. Masonite Corp.*, 21 F.Supp. 551 (D. Del. 1937) in support of its mandatory interpretation of the "shall issue" language. In *Gypsum,* the court held that the defendant had a legal right to pay the final patent fee. In interpreting identical "shall issue" language in an earlier version of § 151, the court stated that "the Commissioner is bound by statute to issue the patent" once the final fee has been paid. *United States Gypsum Co. v. Masonite Corp.*, 21 F.Supp. 551, 552 (D. Del. 1937). Defendant discounts the *Gypsum* holding by noting that there, as in *Brenner,* the issue before the court was not whether the PTO has the authority to withdraw a patent application from issue after payment of the issue fee; it was whether the district court should enjoin a patent applicant from paying the issue fee on its allowed application. Accordingly, defendant argues, and the Court agrees, this holding has no relevance to the present case. As with *Brenner,* the Court places no reliance on the language plaintiff cites.

Finally, plaintiff cites *Sampson v. Dann*, 466 F.Supp. 965 (D.D.C. 1978), *aff'd* 610 F.2d 1000 (D.C. Cir. 1979), which is factually analogous to the present case. In a prior lawsuit, the *Sampson* court had remanded the *Sampson* plaintiff's case to the

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PTO for the purpose of granting plaintiff a reissue patent. On remand, the PTO examiner completed the patent examination, the PTO sent plaintiff a notice of allowance, and plaintiff timely paid the fee. The PTO mailed plaintiff a notice scheduling the issuance of the patent. Before the patent was issued, however, a defendant in a separate patent infringement action brought by Sampson contacted the PTO to inform the PTO of prior art not considered during the review of the original application. In response, PTO officials examined the prior art, and directed that the prior art be withdrawn from issue because the prior art raised doubts about patentability. Plaintiff returned to court and argued that he was entitled to have the patent issued. The court agreed, holding that Congress' command in § 151 that "'the patent shall issue' created an enforceable right in Sampson." *See Sampson v. Dann*, 466 F.Supp. 965, 972 (D.D.C. 1978). The court also postulated that "[t]he Patent and Trademark Office's over-all effectiveness as a protector of that public interest might well be enhanced by strict and merciful cut-off of Patent and Trademark Office consideration of an individual patent application once notice and payment have been effected, particularly one that has been so prominent and protracted as Sampson's." *Id.*

Unlike the *Brenner* and *Gypsum* courts, the *Sampson* court considered the issue presented in the present case: whether

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defendant has the authority to refuse to issue a patent once the issue fee has been paid. Accordingly, defendant addresses it by citing a more recent case from this court, *Harley v. Lehman*, 981 F.Supp. 9 (D.D.C. 1997), which also considered the issue in the present case, but which discounts the *Sampson* case because of a subsequent change in the PTO's implementing regulations.

Harley is factually and procedurally identical to the present case. In *Harley*, plaintiff's application was allowed, plaintiff paid the issue fee, and a patent number and issue date were set. Just five days before the issue date, pursuant to 37 C.F.R. § 1.313(b)(3), the PTO withdrew the application, because a PTO director became concerned about the possible unpatentability of the application's claims. The applicant sued in district court, asserting, as Blacklight does, that the Commissioner lacked the statutory authority to withdraw the patent once the issue fee had been paid. The *Harley* court held that the .PTO regulation allowing withdrawal of a patent from issue based on unpatentability was a reasonable interpretation of 35 U.S.C. § 151. The court also noted the historic coexistence of the ostensibly vying statutes as further proof that the PTO's interpretation was reasonable.

The *Harley* court specifically discounted the *Sampson* case. Like Blacklight, the *Harley* plaintiff relied on *Sampson*. The *Harley* court held, however, that "[p]laintiff's reliance on

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Sampson v. Dann . . . is misplaced. . . . [because t]he

regulation at issue in this case had not yet been enacted when

Sampson was decided."[8] *Harley*, 981 F.Supp. at 12 n.3. The

Sampson court considered the interplay between 35 U.S.C. § 151

and 37 C.F.R. § 1.313(b) before the unpatentability ground, or

subsection (3), had been added to the latter provision.

Accordingly, the provision allowed the PTO to withdraw the patent

after payment of the issue fee only in cases of (1) a mistake on

the part of the Office, and (2) a violation of § 1.56 [fraud] or

illegality in the application. The *Sampson* court held that,

since there was evidence of neither mistake nor fraud, the PTO

was legally bound to issue plaintiff's patent. Defendant's

argument on this score, therefore, is double-edged: not only is

Sampson totally void of persuasive authority here, but *Harley* is

controlling.[9]

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[8]   When *Sampson* was decided in 1978, the PTO's regulations
did not expressly allow withdrawal on the basis of
unpatentability after payment of the issue fee. The regulation
was amended in 1982 specifically to allow withdrawal from issue
on the basis of "unpatentability of one or more claims." *See* 37
CFR § 1.313(b)(3).

[9]   At the May 22, 2000 hearing, plaintiff argued that
there actually is no functional difference between the *Sampson*
court's consideration of the pre-subsection (3) regulation and
the *Harley* court's consideration of the post-subsection (3)
regulation. *See* May 22, 2000 Hr'g Tr. at 63. Plaintiff argued
that, in *Harley*, the PTO indicated that they relied on the
mistake exception to justify the withdrawal of the *Harley*
plaintiff's patent, and that the mistake was the unpatentability
of plaintiff's claim. In other words, plaintiff argues defendant
slid subsection (3) unpatentability under subsection (1)

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The Court finds that *Harley*, and not *Sampson*, is the more persuasive authority. First, the *Sampson* opinion, in a crucial section, includes language that effectively approvingly presages the addition of subsection (3):

> It may be that fraud by the applicant, or even good cause for the failure by the Patent and Trademark Office to discover the prior art earlier would justify a court- fashioned exception to the statutory command. For example, Patent and Trademark Office custom might have established and Congress might have accepted such an exception. But the Patent and Trademark Office has failed to offer any persuasive proof of such a custom or its acceptance by Congress. Moreover, there is a substantial difference between fraud or other questionable action by an applicant which might justify such an exception and the receipt of prior art allegations raising routine substantive questions about patentability of a widely known invention claim which is at least ten years old. *Sampson,* 466 F.Supp. at 972-3.

Second, the Court is persuaded that the fact that the *Harley* court squarely considered subsection (3), while the *Sampson* court did not, makes *Harley* more persuasive. Accordingly, this Court finds that, under the applicable caselaw, defendant's interpretation of the governing patent issuance statutes is reasonable.

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exception. Therefore, both courts were actually considering the same subsection -- subsection (1) -- and the fact that subsection (3) had been passed is of no consequence. *Id.* The Court disagrees. The *Harley* opinion clearly indicates that subsection (3), and not subsection (1), was at issue. See Harley, 981 F.Supp. at 9, 11.

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B. Which PTO Issuance Constituted Reviewable Final Agency Action

The parties disagree over which of the February 17 Notice or the March 22 Decision constituted final, reviewable agency action under the APA. Under 5 U.S.C. § 704, "[a]gency action made reviewable by statute and final agency action for which there is no other adequate remedy in a court are subject to judicial review." For these purposes, " 'agency action' includes the whole or part of an agency rule, order, license, sanction, relief, or the equivalent or denial thereof, or failure to act...." 5 U.S.C. § 551(13). The parties do not dispute whether the February 17 Notice and the March 22 Decision constitute "agency action" under the meaning of the statute; they disagree over which agency action is "final" and therefore "reviewable."

Plaintiff contends that the February 17 Notice is the final, reviewable agency action. See Pl.'s Mot. for Summ. J. at 31-3. Courts must interpret the "finality" element flexibly and practically. See Abbott Laboratories v. Gardner, 387 U.S. 136, 149 (1967). Furthermore, in order to be final, the ruling must not have been issued by a subordinate official. See Franklin v. Massachusetts, 505 U.S. 788, 797 (1992). Plaintiff argues that the February 17 Notice constitutes the PTO's final action because that Notice effectively vitiated the enforceable right to the '601 patent that arose upon plaintiff's payment of the issue fee.

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It was definitive action, in that plaintiff's patent counsel's efforts to reverse the Notice were unavailing. And, practically speaking, it had the very concrete effect of delaying Blacklight's planned public offering.

Plaintiff further argues that the February 17 Notice is the final agency action because the March 22 Decision is merely a post hoc, pretextual rationalization cooked up for litigation purposes. The March 22 Decision was issued after plaintiff filed its lawsuit. Plaintiff characterizes the Decision as a new record made for the reviewing court. *See Consumer Federation of America v. U.S. Department of Health and Human Services*, 83 F.3d 1497, 1506 (D.C. Cir. 1996). Accordingly, plaintiff argues, the Court should not consider it the final agency action.

Defendant responds, and the Court agrees, that the March 22 Decision constitutes the "final agency action within the meaning of 5 U.S.C. § 704 for purposes of seeking judicial review." *See* Pl.'s Mot. for Summ. J., Ex. 8, n. 1.

C.   Administrative Procedure Act Claims: Whether the PTO's March 22 Decision Was Arbitrary and Capricious

Plaintiff argues, alternatively, that even if the Court is convinced that § 151 does not forbid the withdrawal of an application from issue after payment of the issue fee, the PTO's withdrawal of the patents-in-application was arbitrary and capricious in violation of the Administrative Procedure Act

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(APA), 5 U.S.C. § 706 *et seq.* The APA authorizes the Court to issue an injunction to "compel agency action unlawfully withheld," 5 U.S.C. § 706(1), and therefore, plaintiff contends, this Court is authorized to order the PTO to issue the 5 patent applications as patents. The APA also authorizes the Court to "hold unlawful and set aside agency action . . . found to be arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law," or agency action that is "in excess of statutory jurisdiction authority, or limitations, or short of statutory right." 5 U.S.C. § 706(2)(A), (C).

Plaintiff avers that the PTO, in contravention of its own proffered justification for withdrawal of the patents-in-application, did not make the required determination of unpatentability. Here, the March 22 decision upholding the February 17 notice indicated that the PTO relied on 37 C.F.R. § 1.313(b)(3), which allows withdrawal due to the "unpatentability of one or more claims," to justify its withdrawal of the patents-in-application. Plaintiff interprets that regulation to mean that a patent can be withdrawn only upon a finding of unpatentability, not upon a possibility of unpatentability. But, plaintiff points out, the March 22 decision indicates that the February 17 notice was issued at the PTO Director's request because she believed that Blacklight's applications "raise[d] a substantial question of patentability on one or more claims."

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March 22 Decision at 2. Therefore, by defendant's own admission, the PTO has not made a final determination on unpatentability, and so acts in violation of its own regulations, and the APA.

Defendant responds that plaintiff makes this argument about PTO regulations without citing any authority. On the other hand, defendant's own Manual of Patent Examining Procedure (MPEP) § 1308.1 makes clear that withdrawal on the basis of unpatentability after payment of the issue fee is a 2-step process: first, "the actual withdrawal will be handled by the Office of Patent Publications and then the application will be returned to the examiner" and the unpatentable claims are rejected. Defendant further points out that this interpretation of the PTO regulation was upheld in *Harley*, in which the applicant's claims were not formally rejected until 6 months after his application had been withdrawn from issue. *Harley*, 981 F.Supp. at 12.

The Court is persuaded by the defendant's argument. The unpatentability subsection functions as a last-chance procedural measure to enable defendant to observe the PTO's central mandate of issuing viable patents. It is not a final pronouncement of unpatentability. The March 22, 2000 Decision informed plaintiff of this posture; it stated that the Director's decision to withdraw the patent from issue did not constitute either a rejection or an adverse action on the ultimate determination of

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unpatentability. *See* Pl.'s Mot. for Summ. J., Ex. 8 at 4.

Plaintiff has remedies outside this suit and this Court. *See* May

22, 2000 Hr'g Tr. at 55-59. Those remedies undermine plaintiff's

suggested interpretation of the statute. Any subsection (3)

determination of unpatentability will necessarily represent only

a possibility of unpatentability, since such a determination, as

defendant has made abundantly clear, is not in any way a final

rejection. The PTO's withdrawal of plaintiff's patent

application in order to reconsider its patentability was neither

arbitrary nor capricious.[10]

V.   Conclusion

For the foregoing reasons, it is hereby

ORDERED that defendant's motion for summary judgment [13-1]

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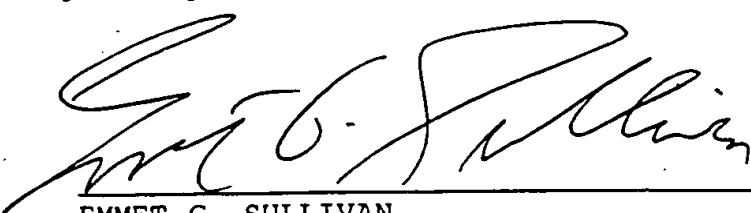
[10]   This Court is troubled by several steps in the PTO's
process, however. Defendant claims that the technology of the
'294 application contravenes fundamental laws of chemistry and
physics, yet the application was approved by a patent examiner,
never reviewed by a supervisor, and would have issued as a
patent but for the PTO's eleventh hour withdrawal. Defendant
conceded at the May 22, 2000 hearing that the '294 application
was withdrawn just days before the issuance date without the
benefit of any PTO employee's re-evaluating the file. Also, the
February 17 Notice, released twelve days before the scheduled
issue date, gave no reason for the withdrawal besides a cryptic
citation to 37 C.F.R. § 1.313(b)(3). At the May 22, 2000
hearing, defendant represented that these are common occurrences,
because of the enormous number of patent applications that need
to be addressed each year, and the "tremendous pressure" placed
on patent examiners to produce work. *See* May 22, 2000 Hr'g Tr.
at 48. Defendant may be well-advised to examine its patent
issuance process so that their normal operations are not
compromised by such seemingly suspicious procedures.

is **GRANTED**; and it is

   FURTHER ORDERED that plaintiff's motion for summary judgment

[11-1] is **DENIED**; and it is

   FURTHER ORDERED that the Clerk shall enter final judgment in

favor of defendant and against plaintiff.

_8/14/00_
DATE

_____
EMMET G. SULLIVAN
UNITED STATES DISTRICT JUDGE

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CERTIFICATE OF SERVICE
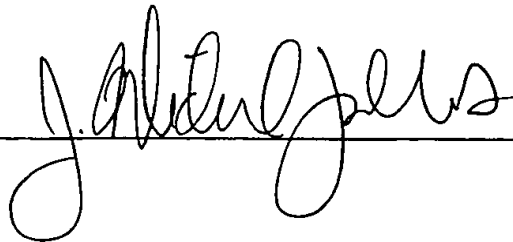
I certify that two true copies of the foregoing BRIEF FOR PLAINTIFF-APPELLANT BLACKLIGHT POWER, INC., were served by overnight delivery on November 6, 2000, on counsel for Defendant-Appellee as follows:

> Barbara Biddle
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CERTIFICATE OF COMPLIANCE

I hereby certify that the foregoing BRIEF FOR PLAINTIFF-APPELLANT BLACKLIGHT POWER, INC., contains 7,767 words as determined by WordPerfect 8.0, which was used to prepare the brief.

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IN THE

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

BLACKLIGHT POWER, INC.,

Plaintiff-Appellant,

v.

Q. TODD DICKINSON,
Director, Patent and Trademark Office,

Defendant-Appellee.

**Appeal from the United States District Court for
the District of Columbia in 00-422 (EGS),
Judge Emmet G. Sullivan**

REPLY BRIEF FOR PLAINTIFF-APPELLANT
BLACKLIGHT POWER, INC.

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February 20, 2001

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I. INTRODUCTION

The Patent and Trademark Office (PTO) has failed to justify its illegal actions in withdrawing the patent applications of BlackLight Power, Inc., after BlackLight had paid the issue fees. The PTO's actions violated the plain language of 35 U.S.C. § 151, which states that "the patent shall issue" once the issue fee has been paid, as well as the language of its own regulation in 37 C.F.R. § 1.313(b)(3). Indeed, the PTO does not even list its failure to follow its own regulation as one of the issues on appeal, even though it was explicitly identified as one of the issues and argued in BlackLight's brief.

Instead, the PTO argues that this Court should defer to its interpretation of section 151, even though the Court has previously held that the PTO's statutory interpretations are not entitled to deference. Such deference would be particularly inappropriate here, where the statute unambiguously commands that "the patent shall issue" once the issue fee is paid. The first sentence of section 151 ("If it appears that applicant is entitled to a patent under the law"), on which the PTO relies so heavily, is not a preamble that modifies the entirety of the rest of the section. It specifies only that, when an applicant is entitled to a patent under the law, "a written notice of allowance of the application shall be given or mailed to the applicant."

At the very least, the PTO could not withdraw BlackLight's '294 application after it was too late to prevent publication in the Official Gazette. By doing so, the PTO clearly violated 35 U.S.C. § 122, which requires that patent applications be kept in strict confidence and prohibits the PTO from giving out any information about pending applications.

Even if the PTO had the statutory authority to withdraw the applications from issue, it violated its own regulation in doing so. 37 C.F.R. § 1.313(b)(3), on which the PTO purportedly relied, provides that, after the applicant has paid the issue fee, the application will not be withdrawn for any reason except the "[u]npatentability of one or more claims." Since the PTO has effectively conceded that it never made any determination that the claims of the '294 application were invalid before withdrawing it from issue, the PTO tries to rewrite its regulation as requiring only a "possibility" or "concern" of unpatentability. That is not what the regulation says. Nor does BlackLight argue that the determination of unpatentability must be "conclusive" or "final," since no one in the PTO ever made *any* determination of unpatentability before withdrawing the '294 application.

Indeed, neither the Group Director, Ms. Kepplinger, nor the Director of Special Programs, Mr. Spar, could have made such a determination of unpatentability because they never saw the '294 application file. Although the PTO tries to distance itself from their clearly arbitrary actions by focusing on the later March 22, 2000, decision of the Deputy Assistant Commissioner, that decision itself focused on the actions of Ms. Kepplinger and Mr. Spar. Since their actions were clearly arbitrary and capricious in withdrawing the '294 application in the first place, the Deputy Assistant Commissioner's decision that they acted within the scope of their authority, without considering their complete lack of review of the relevant facts, cannot justify the PTO's actions.

Accordingly, the district court's grant of summary judgment should be reversed and the case remanded to the district court with instructions to set aside the PTO's illegal actions in withdrawing BlackLight's patent applications and to direct that these applications issue as patents.

II. REPLY ARGUMENT

A. This Court Should Not Defer to Either the District Court or the PTO

1. The PTO Agrees That This Court Reviews the District Court's Decision Without Deference

The PTO agrees that this Court reviews the district court's decision *de novo*. (PTO Br. at 10.) The PTO also agrees that, when the decision below turns on statutory interpretation, as it does here, this Court interprets the statute independently without deference to the district court. (*Id.*)

2. The PTO's Statutory Interpretation Is Not Entitled to Deference Under *Chevron*

Notwithstanding the directly contrary authority in *Merck & Co. v. Kessler*, 80 F.3d 1543, 38 USPQ2d 1347 (Fed. Cir. 1996), the PTO continues to assert that its interpretation of section 151 is entitled to substantial deference under *Chevron U.S.A. Inc. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837 (1984). (PTO Br. at 15, 18-19.) As pointed out in BlackLight's brief (at 13), this Court need not give *Chevron* deference to the PTO's interpretation because the Commissioner does not have substantive rulemaking authority. *Merck*, 80 F.3d at 1549-50, 38 USPQ2d at 1351. BlackLight also cited numerous cases demonstrating that the Court does not defer to the PTO on questions of statutory interpretation. *See, e.g., In re Donaldson Co.*, 16 F.3d 1189, 1994, 29 USPQ2d 1845, 1848 (Fed. Cir. 1994) (*en banc*); *In re Recreative Techs. Corp.*, 83 F.3d 1394, 1397-98, 38 USPQ2d 1776, 1778-79 (Fed. Cir. 1996); *In re Portola Packaging, Inc.*, 110 F.3d 786, 788, 42 USPQ2d 1295, 1297 (Fed. Cir. 1997).

The PTO tries to distinguish *Merck* by arguing that its regulations in 37 C.F.R. § 1.313 are "procedural," not substantive. (PTO Br. at 19.) The PTO's regulations

must be "procedural" because the Commissioner does not have the authority to issue substantive rules. *Merck*, 80 F.3d at 1550, 38 USPQ2d at 1351; *Animal Legal Defense Fund v. Quigg*, 932 F.2d 920, 930, 18 USPQ2d 1677, 1686 (Fed. Cir. 1991). The Commissioner can only establish regulations directed to the "conduct of proceedings" in the PTO, and only then if they are "not inconsistent with law." 35 U.S.C. § 6(a). The authority granted in section 6(a) does not extend to "the Commissioner's interpretation of the patent statutes, whether it be section 101, 102, 103, 112 *or other section." Animal Legal Defense Fund*, 932 F.2d at 930, 18 USPQ2d at 1686 (emphasis added). Thus, the fact that the PTO's interpretation of section 151 may be embodied in a "procedural" rule, even if that rule was issued by the Commissioner under section 6(a), does not entitle it to any deference under *Chevron* since the PTO still lacks substantive rulemaking power. *See Atchison, Topeka & Santa Fe Ry. v. Pena*, 44 F.3d 437, 441-42 (7th Cir. 1994) (*en banc*) (distinguishing between "substantive" rules to which deference is given under *Chevron* and other types of rules), *aff'd*, 516 U.S. 152 (1996).

Significantly, the PTO cites no case in which this Court actually granted *Chevron* deference to the PTO's interpretation of a statute. The only Federal Circuit case cited by the PTO, *Ethicon, Inc. v. Quigg*, 849 F.2d 1422, 7 USPQ2d 1152 (Fed. Cir. 1988), did not hold that the PTO's statutory interpretation should be given deference because it has "procedural" rulemaking authority. (PTO Br. at 18.) While the Court in *Ethicon* cited *Chevron* for the general proposition that "an agency's interpretation of a statute it administers is entitled to deference," 849 F.2d at 1425, 7 USPQ2d at 1154, it did not defer to the PTO at all, but rather struck down the PTO's regulation permitting a stay of reexamination as inconsistent with the statute. Indeed, when the Court later held that the PTO was not entitled to deference in

Merck, it cited *Ethicon* for support. *Merck*, 80 F.3d at 1550 n.6, 38 USPQ2d at 1351 n.6. Thus, *Ethicon* is no help to the PTO's position, but rather supports BlackLight.[1]

In any event, the PTO agrees that, even under *Chevron* and its progeny, the courts do not defer to an agency's interpretation of a statute unless the relevant statute is silent or ambiguous on the question at hand. (PTO Br. at 11.) *See Ad Hoc Comm. v. United States*, 13 F.3d 398, 402 (Fed. Cir. 1994); *Glaxo Operations UK Ltd. v. Quigg*, 894 F.2d 392, 398, 13 USPQ2d 1628, 1633 (Fed. Cir. 1990). As explained in BlackLight's brief (at 14-16), and discussed further below in Section II(B)(1), section 151 is clear and unambiguous on its face that the PTO must issue a patent after the applicant pays the issue fee. Therefore, *Chevron* does not apply.

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[1] The other cases cited by the PTO are either distinguishable or unpersuasive. *Jaskiewicz v. Mossinghoff*, 802 F.2d 532, 535, 231 USPQ2d 477, 479 (D.C. Cir. 1986) (PTO Br. at 19 n.9), merely notes that the Commissioner has the authority to prescribe regulations governing the recognition and conduct of persons practicing patent law under 35 U.S.C. § 31. It says nothing about the PTO's authority to issue substantive rules interpreting the patent statute. *Friedman v. Lehman*, 40 USPQ2d 1206, 1207-08 (D.D.C. 1996) (PTO Br. at 19 n.9), also does not concern interpretation of the patent statute, but rather involved the PTO's interpretation of one of its own disciplinary rules.

Similarly, the PTO cites *In re Alappat*, 33 F.3d 1526, 1534-35, 31 USPQ2d 1545, 1550 (Fed. Cir. 1994) (*en banc*); and *Lorenz v. Finkl*, 333 F.2d 885, 889-90, 142 USPQ 26, 30 (CCPA 1964) (PTO Br. at 19), for nothing more than the unremarkable proposition that the Commissioner has the authority to establish regulations under section 6(a).

Rydeen v. Quigg, 748 F. Supp. 900, 16 USPQ2d 1876 (D.D.C. 1990); and *Hitachi Metals, Ltd. v. Quigg*, 776 F. Supp. 3, 20 USPQ2d 1920 (D.D.C. 1991) (PTO Br. at 18-19), are district court cases decided before the Federal Circuit's decision in *Merck*. Like the appealed decision and the D.C. district court's decision in *Harley v. Lehman*, 981 F. Supp. 9, 44 USPQ2d 1699 (D.D.C. 1997), they are not binding on this Court.

3. The PTO's "Longstanding Interpretation" of Section 151 Does Not Entitle It to Deference

Nor should the PTO's supposed "longstanding interpretation" of section 151 entitle it to deference. *See Donaldson*, 16 F.3d at 1194, 29 USPQ2d at 1849 (rejecting PTO's interpretation of 35 U.S.C. § 112, ¶ 6, despite its longstanding practice of not applying statute); *Recreative Techs.*, 83 F.3d at 1397, 38 USPQ2d at 1779 (rejecting PTO's interpretation of reexamination statute despite its reliance on Manual of Patent Examining Procedure). "The fact that the PTO may have failed to adhere to a statutory mandate over an extended period of time does not justify its continuing to do so." *Donaldson*, 16 F.3d at 1194, 29 USPQ2d at 1849.

The PTO argues that *Donaldson* is distinguishable because that case involved a situation where "the statute and rule were directly contradictory." (PTO Br. at 17.) That was not the PTO's position in *Donaldson*, however, when it tried to argue that the particular statute, 35 U.S.C. § 112, ¶ 6, was "ambiguous" because it did not specifically state that it applied to patent prosecution. *Donaldson*, 16 F.3d at 1194, 29 USPQ2d at 1849. The Court rejected the PTO's argument, as it should here.

Further, the Court in *Donaldson* expressly rejected the same argument the PTO makes here regarding "Congressional silence." *Id.*, 16 F.3d at 1193 n.3, 1194, 29 USPQ2d at 1848 n.3, 1849. (See PTO Br. at 16-17.) Unless there is specific evidence that Congress was aware of the PTO's practice, and the PTO has provided no such evidence in this case, Congress's silence is meaningless. *See id.* at 1193 n.3, 29 USPQ2d at 1848 n.3.

Finally, the PTO's arguments on this point are completely inconsistent. First, the PTO argues that *"for almost ninety years* [its] regulations have authorized the withdrawal of an application before it has issued even though the issue fee has been

paid," and that it "has withdrawn applications from issue after payment of the issue fee *for at least the last 125 years.*" (PTO Br. at 16; emphasis added.)[2] The PTO then turns around and argues that cases decided before 1982, such as *Sampson v. Dann*, 466 F. Supp. 965, 201 USPQ 15 (D.D.C. 1978), should be ignored because the current regulation was not yet enacted. (PTO Br. at 23.)[3]

The PTO cannot have it both ways. Accordingly, its supposed "longstanding interpretation" of section 151 should have no bearing on the proper interpretation of section 151. In any event, it is ultimately for this Court to decide whether the PTO's interpretation violates the plain language of the statute. *See Ethicon*, 849 F.2d at 1425, 7 USPQ2d at 1154 ("[T]he courts are the final authorities on issues of statutory construction.").

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[2] The PTO relies on two very old cases, *Hull v. Commissioner of Patents*, 9 D.C. (2 MacArth.) 90 (D.C. 1875); and *Ex Parte Hunt*, 1878 Dec. Comm'r Pat. 149, 13 Official Gazette 771 (Comm'r Pat. 1878), for this latter proposition, but they were actually decided long before the statute, R.S. 4885, was amended in 1908 to tie issuance of the patent to payment of the issue fee. Consequently, these cases are irrelevant to the PTO's alleged "longstanding" interpretation of the current statutory language in section 151.

[3] The PTO acknowledges that *Sampson* considered the issue presented in this case. (PTO Br. at 23). Specifically, the court in *Sampson* held that the command in section 151 that "the patent shall issue" created an "enforceable right," and that the PTO was required to issue the patent after the applicant paid the issue fee. 466 F. Supp. at 973, 201 USPQ at 22. Contrary to the PTO's argument, the *Sampson* court did not suggest that any "later enacted exceptions" to section 151 would be valid. (PTO Br. at 24 n.11). The court merely observed that the PTO had not established any exception, such as "fraud or other questionable action by an applicant," which might justify an exception to section 151. 466 F. Supp. at 973, 201 USPQ at 21. Thus, the court specifically rejected the PTO's argument that mere "unpatentability" could justify its disregard of the statute.

B.   **The PTO's Actions Violated the Plain Language of 35 U.S.C. § 151**

1.   **Section 151 Unambiguously Commands Issuance of the Patent After Payment of the Issue Fee**

In its attempt to invoke the *Chevron* standard, the PTO rewrites the district court's opinion, referring to a supposed "finding" by the court that section 151 is "ambiguous." (PTO Br. at 10.) The court made no such "finding," however, relying instead on *Harley v. Lehman*, 981 F. Supp. 9, 44 USPQ2d 1699 (D.D.C. 1997), and the PTO's argument supposedly based on the "plain language" of the statute. *BlackLight Power, Inc. v. Dickinson*, 109 F. Supp.2d 44, 48, 55 USPQ2d 1812, 1815 (D.D.C. 2000). (A10.)

The PTO's argument is hardly based on the "plain language" of the statute. It argues that the section 151 is "ambiguous" because it fails to "expressly state whether a patent application having serious patentability concerns that has not yet issued can be withdrawn even though the issue fee has been paid." (PTO Br. at 12.) To the contrary, the language of the statute could not be more clear in its command that, "[u]pon payment of [the issue fee] *the patent shall issue.*" Moreover, the fact that section 151 does not specifically admonish the PTO that it cannot withdraw an application after the issue fee has been paid does not mean that it is ambiguous in this respect. *See Donaldson*, 16 F.3d at 1194, 29 USPQ2d at 1849 (fact that 35 U.S.C. § 112, ¶ 6, does not specifically state that it applies during prosecution does not make it ambiguous).

Indeed, in its attempt to create an ambiguity where none exists, the PTO distorts the language of section 151 beyond recognition. It argues that "[s]ection 151 allows issuance only '[i]f it appears that applicant is entitled to a patent under the

law." (PTO Br. at 9, 13.) That it not what the statute says. Section 151 provides that,

"[i]f it appears that applicant is entitled to a patent under the law, *a written notice of allowance of the application shall be given or mailed to the applicant*" (emphasis added). Following the express wording of the statute, the examiner determined that BlackLight was entitled to a patent and issued a written Notice of Allowance. (A135.)[4]

In support of its strained reading of the statute, the PTO also cites *Harley* as holding that section 151 premises the issuance of a patent on the PTO's mandate to issue only valid patents. (PTO Br. at 7; see also A10.) Even the district court in *Harley*, however, recognized that the first sentence of section 151 ("If it appears that applicant is entitled to a patent under the law") is not a preamble that modifies the rest of the section. 981 F. Supp. at 11, 44 USPQ2d at 1701-02. Although the PTO argues that section 151 should be read "as a whole" (PTO Br. at 13-14), it never explains how the introductory clause of section 151 modifies the following paragraph in which the statutory command that a patent "shall issue" appears. Rather, as the court explained in *Brenner v. Ebbert*, 398 F.2d 762, 157 USPQ 609 (D.C. Cir. 1968), under the statutory framework, examination of a patent application is complete when the application is allowed. "Congress established a separate statutory framework for

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[4] The PTO tries to undermine the competence of its own examiner by asserting that he never addressed BlackLight's theory that "the electron in a hydrogen atom can be relaxed to produce vast quantities of energy." (PTO Br. at 3 n.1.) As it has done throughout this case, the PTO fails to make any distinction between the claims of the '294 application, which are directed to new compositions of matter, specifically hydride compounds, and claims to a method for releasing energy from hydrogen atoms, as in the issued '935 patent. Moreover, in conducting his examination of the '294 application, the patent examiner raised issues related to operability under 35 U.S.C. § 101 (A129; A399), which he eventually withdrew and issued the Notice of Allowance.

what remains–issuance of the patent. It is a relatively ministerial act; if the issue fee is timely tendered, the patent must issue." *Id.* at 764, 157 USPQ at 611.

Not only does the PTO distort the statute, but it twists BlackLight's argument as well. BlackLight does not argue that the "language in the statute requires the Director to issue the patent upon payment of the issue fee *regardless of whether the condition set forth in the first sentence of Section 151 . . . is met.*" (PTO Br. at 13; emphasis added.) In the case of BlackLight's '294 application, the condition in the first sentence of section 151 *was* met. That is why the examiner issued the Notice of Allowance, as expressly provided in the statute. Once that condition was satisfied, however, and BlackLight paid the issue fee, section 151 does not allow the PTO to keep reopening prosecution and reexamining the patent application repeatedly. As with reexamination, once the issue fee is paid, the PTO is not entitled to conclude that "an earlier examination was not conducted properly and to do it again." *Portola*, 110 F.3d at 790, 42 USPQ2d at 1299.

Finally, the PTO argues that "[s]ection 151 merely serves to guide [it] in establishing an order of procedure prior to an application issuing." (PTO Br. at 14.) Although the PTO would like to treat section 151 as a "guide," the statute uses the word "shall," which is the "language of command." *Boyden v. Commissioner of Patents*, 441 F.2d 1041, 1043 n.3, 168 USPQ 680, 681 n.3 (D.C. Cir. 1971).[5] Thus,

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[5] Similarly, in *LO Shippers Action Comm. v. ICC*, 857 F.2d 802, 806 (D.C. Cir. 1988), cited by the PTO (Br. at 14), the court held that the use of the word "shall" generally indicates the absence of discretion and the word "may" indicates its presence. In a different context, the court in *United Hosp. Center, Inc. v. Richardson*, 757 F.2d 1445, 1453-54 (4th Cir. 1985), also cited by the PTO (Br. at 14), held that the term "may" as used in a regulation was also mandatory.

section 151 unambiguously commands that the PTO must issue a patent after the applicant pays the issue fee.

2. The PTO's Regulation Is Invalid

As authority for withdrawing the '294 application, the PTO relies on 37 C.F.R. § 1.313(b)(3), which provides that an application may be withdrawn for "[u]npatentability of one or more claims" after the issue fee has been paid. Section 1.313(b), however, is inconsistent with the statutory mandate in section 151 that a patent *shall* issue after payment of the issue fee and is therefore invalid.

Once again, the PTO tries to justify its regulation on the ground that it has a "higher obligation" to issue only valid patents. (See PTO Br. at 12.) *See also BlackLight*, 109 F. Supp.2d at 49-50, 55 USPQ2d at 1816-17. (A12; A14.) The PTO does not have the authority to ignore procedures prescribed by law, however, merely because it believes it can construct better procedures. *See Natural Resources Defense Council, Inc. v. Herrington*, 768 F.2d 1355, 1396 (D.C. Cir. 1985).

This Court rejected a similar argument in *In re Recreative Techs. Corp.*, 83 F.3d 1394, 38 USPQ2d 1776 (Fed. Cir. 1996), where the PTO argued that it could reexamine patent claims on grounds previously considered despite the explicit statutory language allowing reexamination of a patent only if there is a "substantial new question of patentability." Even though reexamination might show that the requirements for patentability had not been met, the Court held that the "power [to reexamine questions of patentability decided in original examination] can not be acquired by internal rule of procedure or practice." *Id.* at 1398, 38 USPQ2d at 1779.

Finally, even assuming that section 1.313(b)(3) affords the PTO a "last-chance procedural measure" to issue only valid patents, *BlackLight*, 109 F. Supp.2d at 54, 55 USPQ2d at 1820 (A24), there must be limits. The limit was exceeded here when the

PTO withdrew the '294 application so late that it could not prevent publication in the Official Gazette. Specifically, the February 29, 2000, Official Gazette contains a notice of the issuance of U.S. Patent No. 6,030,601, based on the '294 application, including the entire text of claim 17 and one of the figures. (A155-56.) Since the patent did not issue, this publication was a clear violation of 35 U.S.C. § 122, which provides that "[a]pplications for patents shall be kept in confidence by the Patent and Trademark Office and *no information concerning the same given without authority of the applicant*" (emphasis added). *See also* 37 C.F.R. § 1.14(a) ("No information will be given concerning the filing, pendency, or subject matter of any application for patent . . .").[6] At the very least, section 1.313(b)(3) cannot be used to withdraw an application after it is too late to prevent publication, which would result in a violation of section 122.

C. The PTO Did Not Follow Its Own Regulation

1. No One in the PTO Ever Determined that the '294 Application Claims Were Unpatentable

The PTO is noticeably silent in response to BlackLight's argument that the PTO failed to follow its own regulation. The PTO purportedly withdrew the '294 application from issue pursuant to 37 C.F.R. § 1.313(b)(3), which provides that, after the applicant has paid the issue fee, the application will not be withdrawn from issue for any reason except for the "[u]npatentability of one or more claims." As pointed out in BlackLight's brief, however, there is nothing in the administrative record showing that the Group Director, Ms. Kepplinger, or anyone else in the PTO, ever

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[6] Although the PTO subsequently published an erratum in the Official Gazette indicating that the patent was not granted (A79-80; A416), it did not cure the violation of section 122.

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determined that the claims of the '294 application were unpatentable. (BlackLight Br. at 23.) Indeed, when the Notice withdrawing the '294 application issued on February 17, 2000, Ms. Kepplinger could not possibly have known whether the claims were unpatentable because she had never even seen the claims. (A40; A53; A131.) Nearly two weeks later on February 28, 2000, she still did not have the '294 application file. (A133.)

Although the PTO's failure to follow its own regulation was specifically identified as one of the issues in BlackLight's brief (at 1, 23-25), the PTO does not even list it in its statement of the issues. Nor does it dispute the fact that no one ever made an actual determination of "unpatentability of one or more claims" as required by the regulation. Instead, the PTO tries to get around the language of its regulation by arguing that section 1.313(b)(3) does not require a "conclusive" determination of unpatentability before withdrawing an application. (PTO Br. at 26.)

The PTO's argument, however, completely fails to respond to BlackLight's point. BlackLight has never argued that section 1.313(b)(3) requires a "conclusive" determination of unpatentability. But it does require at least *a* determination of unpatentability as a prerequisite to withdrawing an application. BlackLight has contended all along that the PTO made *no* determination of unpatentability *at all*, a point which the PTO has apparently admitted. Even the decision issued March 22, 2000, implicitly acknowledged that there had been no determination of unpatentability of the '294 claims, only that "[a]n Office Action addressing the merits of the application *or* a supplemental Notice of Allowance will issue in due course." (A153; emphasis added.) Accordingly, the PTO never made any determination of "unpatentability" as required by section 1.313(b)(3) before withdrawing the '294 application.

2. 37 C.F.R. § 1.131(b)(3) Does Not Permit a Mere "Possibility" or "Concerns" of Unpatentability

Since the PTO cannot show that it ever determined the claims of the '294 application were unpatentable, it tries to rewrite the words of the regulation to cover BlackLight's situation. For example, the PTO asserts that it can withdraw an application if it believes "the application has serious patentability problems" (PTO Br. at 21) or it has "reasonable concerns about the patentability of the claims" (PTO Br. at 24-25). Just like the district court's misreading of section 1.313(b)(3) as requiring only a "possibility of unpatentability," *BlackLight*, 109 F. Supp.2d at 54, 55 USPQ2d at 1820 (A25), none of the PTO's "interpretations" finds any support in the regulation. To the contrary, allowing the PTO to withdraw an application based on the mere "possibility" or "concerns" of unpatentability would make the notice of allowance and the regulation in section 1.313(b)(3) meaningless. By its own terms, the regulation prohibits withdrawal after the issue fee has been paid except in specifically defined circumstances: "Once the issue fee has been paid, the Office *will not* withdraw the application from issue at its own initiative for any reason *except* . . . [u]npatentability of one or more claims. " 37 C.F.R. § 1.313(b)(3) (emphasis added).

The PTO's reliance on *Harley v. Lehman*, 981 F. Supp. 9, 44 USPQ2d 1699 (D.D.C. 1997), as support for its "interpretation" of section 1.313(b)(3) is also misplaced. Like the district court's opinion, the PTO is simply wrong that "*Harley* is factually indistinguishable from this case." (PTO Br. at 20; see A18.) Moreover, the PTO knows it is wrong. It argues that, "[j]ust as in *Harley*, the basis for the withdrawal was *the group director's concern about the patentability of the claimed invention.*" (PTO Br. at 21; emphasis added.) As the PTO well knows, however, the

Group Director in *Harley* had more than a mere "concern" about patentability. Specifically, it told the district court in that case that it had complied with section 1.313(b)(3) because the Group Director had actually determined that one or more claims were unpatentable. (A596-97.) If anything, *Harley* supports BlackLight's argument that section 1.313(b)(3) requires the PTO to have made an actual determination of unpatentability before withdrawing an application. Thus, if this Court were to follow *Harley*, it should hold that the PTO must have made an actual determination of unpatentability as it argued was necessary in that case.

In any event, the inconsistency between the PTO's positions in *Harley* and here, as well as the plain language of section 1.313(b)(3), compels reversal of the PTO's actions in this case. Wholly apart from *Harley*'s inconsistency with *Merck*, there is nothing in the administrative record that shows anyone in the PTO ever determined that the claims of the '294 application are unpatentable before it withdrew the application.

D. The PTO's Actions Were Arbitrary and Capricious

1. No One in the PTO Ever Reviewed the '294 Application Before It Was Withdrawn

The PTO provides no satisfactory response to BlackLight's argument that the PTO's actions were arbitrary and capricious. The PTO does not dispute the fact that neither the Group Director, Ms. Kepplinger, nor the Director of Special Programs, Mr. Spar, ever reviewed the '294 application file before it was withdrawn. Although nothing in the regulations specifically requires "actual review of the file prior to making an initial decision to withdraw an application from issue" (PTO Br. at 25), the PTO must still examine the relevant facts and there must be a rational connection between the facts relied on and the decision made. *See Motor Vehicle Mfrs. Ass'n*

v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 43 (1983) (holding that agency must examine relevant data and articulate "rational connection between the facts found and the choices made"). Since she never reviewed the file, Ms. Kepplinger decided to withdraw the '294 application without even knowing what the application disclosed, the scope of the allowed claims, or whether the same issues had already been raised during prosecution before the examiner. Mr. Spar mistakenly thought that the application was directed to "cold fusion." (A51; A131; A555.)

Throughout its brief, the PTO tries to justify Ms. Kepplinger's failure to review the '294 application file on the ground that it is directed to "similar technology" as the issued '935 patent. (See PTO Br. 3, 4, 5 n.3.) For example, the PTO asserts that Ms. Kepplinger "became aware that the pending '294 application was directed at similar novel technology" as the issued '935 patent. (PTO Br. 4.) That assertion is incredible, however, in view of the undisputed fact that Ms. Kepplinger never reviewed the '294 application file. There is clearly no support for it in the administrative record.[7]

Instead, the PTO speculates that Ms. Kepplinger somehow used the PTO's "human and computer resources" in making this determination. (PTO Br. at 5 n.3.) The only support the PTO can muster for this assertion, however, is a citation to the Associate Solicitor's argument to the district court. (A770-71.) Without any supporting evidence, he suggested to the court that Ms. Kepplinger may have looked at the title of the '294 application on a computer screen. (*Id.*) Argument by counsel

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[7] The PTO also argues that Ms. Kepplinger's decision was "based on concerns that the *claimed invention* violates the known laws of physics and chemistry." (PTO Br. at 9, 21; emphasis added.) Of course, that is not true either since Ms. Kepplinger never saw the claims of the '294 application.

does not constitute evidence. *In re Teledyne Indus., Inc.*, 696 F. 2d 968, 971, 217 USPQ 9, 11 (Fed. Cir. 1982).

Even if the PTO's assertion is true, the fact that Ms. Kepplinger might have based her determination on the title of the '294 application, without reviewing the file, magnifies the arbitrariness of her decision. The title of the '294 application, "Hydride Compounds," clearly indicates that it concerns different subject matter than the '935 patent, which is titled "Lower-Energy Hydrogen Methods and Structures." Unlike the '935 patent, which concerns methods and apparatus for releasing energy from hydrogen atoms, the '294 application is directed to *compositions of matter*, which include conductive magnetic plastics and high-strength coatings. Since the decision to withdraw the '294 application from issue was not based on a review of the relevant facts, but only a presumably valid issued patent, the decision was arbitrary and capricious.

2.   The March 22, 2000, Decision Did Not Insulate the Group Director's Arbitrary Actions from Review

The PTO tries to distance itself from the clearly arbitrary actions in withdrawing the '294 application before it was scheduled to issue on February 29, 2000, and instead focuses on the March 22, 2000, decision. (PTO Br. at 24-25.)[8] Even assuming that the March 22 decision represents the "final" agency action for purposes of seeking judicial review (A146 n.1), the PTO is wrong that Ms. Kepplinger's actions are "irrelevant." (PTO Br. at 27, 28.) Nothing in the March 22,

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[8] In discussing the March 22, 2000, decision, the PTO refers to three letters submitted by BlackLight "to withdraw the pending application from issue." (PTO Br. at 5.) BlackLight's letters asked the PTO to do exactly the opposite—to reconsider the withdrawal of BlackLight's applications and issue them as patents. (A49-53; A144-45.)

2000, decision indicates that Deputy Assistant Commissioner Stephen G. Kunin made an independent determination that the claims of the '294 application were unpatentable. (A146-54.) Instead, by its own terms, the decision merely reviewed the record and found that Ms. Kepplinger and Mr. Spar "did not act improperly in withdrawing the application from issue." (A153.) Specifically, the decision found that (1) the record did not show that Mr. Spar "acted beyond the scope of [his] authority" (A150); and (2) Ms. Kepplinger "was not prohibited from determining anew that the technology embraced by the instant application lacked patentability of one or more claims" (A151).

The March 22, 2000, decision failed to consider, however, whether Ms. Kepplinger ever actually determined whether the claims were unpatentable or even reviewed the '294 application file. Although the March 22 decision states that the withdrawal was "due to the Director's [Ms. Kepplinger's] determination that one or more claims lacked patentability" (A150), that clearly was not true since Ms. Kepplinger never even saw the file for the '294 application. To the contrary, nothing in Ms. Kepplinger's declaration indicates she ever made an actual determination of unpatentability of any of the claims, but rather she had some vague "patentability concerns." (A552.)[9]

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[9] The PTO also argues that "BlackLight does not dispute the reasonableness of the Director's [March 22] decision to withdraw the '294 application due to the applicant's questionable science." (PTO Br. at 25.) BlackLight did not "dispute" this assertion by the PTO because the Deputy Assistant Commissioner never decided that the '294 application was based on "questionable science" in his March 22, 2000, decision. Although he found that the Group Director, Ms. Kepplinger, "reasonably" requested withdrawal of the '294 application (A150), and otherwise referred to the "reasonableness" of her decision (A151), BlackLight showed that Ms. Kepplinger's decision was anything but "reasonable" since it was not based on a review of the relevant facts.

Consequently, the PTO cannot use the Deputy Assistant Commissioner's March 22, 2000, decision, which merely reviewed Ms. Kepplinger's and Mr. Spar's actions, to place those actions beyond review. Even assuming that the Deputy Assistant Commissioner had found the '294 application file by then, he did not independently determine that the claims were unpatentable. Since Ms. Kepplinger's and Mr. Spar's actions were clearly arbitrary and capricious in withdrawing the '294 application in the first place, the Deputy Assistant Commissioner's decision that they acted within their scope of authority, without also considering their complete lack of review of the relevant facts, cannot justify the PTO's actions. *See Yepes-Prado v. U.S. INS*, 10 F.3d 1363, 1370 (9th Cir. 1993) ("Agencies abuse their discretion no less by arriving at plausible decisions in an arbitrary fashion than by reaching unreasonable results.")

3.   **The District Court Was Also "Troubled" by the PTO's "Seemingly Suspicious Procedures"**

Finally, the PTO tries to dismiss the district court's concerns about the PTO's "seemingly suspicious procedures" as relating only to the timing of its actions before the March 22, 2000, decision. (PTO Br. at 26 n.12.) A review of the hearing transcript before the district court, however, shows that it was concerned about much more than just timing. In particular, the court was concerned about what exactly triggered Ms. Kepplinger to withdraw the '294 application in the first place, finding the PTO's entire explanation to be "sort of mysterious." (A710.) More importantly, as shown in the following excerpts, the court was clearly troubled by Ms. Kepplinger's failure to review the '294 application file:

> MR. SELTER [BlackLight's Counsel]: . . . [I]t seems everybody who looks at the data is convinced that it works, and perhaps if the government, if Group Director

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Kepplinger had looked at the data when she made the decision, she would be convinced, too.

THE COURT: And it's clear from the record that she did not look at the data.

MR. SELTER: It's clear that she did not look at the 294 application; that's correct. All that is in the record is that she looked at the 935 patent.

THE COURT: *That's another reason why this case is very troubling.* (A762; emphasis added.)

* * *

THE COURT: . . . *[T]his whole process is very troubling.* One day, the Director goes to her office and she starts looking at 935, not 294. She examines the application, 935, and then she's troubled, and then, somehow or another, she, quote/unquote, becomes further aware of the 294 being issued. There's nothing in this decision to indicate that she ever looked at 294, is there?

MR. BAER [PTO's Counsel]: No. We would admit that, on February 17th, she did not have the 294 application in front of her, because it was off at the printers –

THE COURT: Right.

MR. BAER: – But she knew enough about it that she could make a determination that "We need to look at this again." Now, had we pulled the wrong file, the wrong application – for instance, if the 294 had to do with toasters – we would have issued that by now. We wouldn't be here. We have subsequently looked at it. The final decision, the agency says, "We have looked at the application and we are concerned about the application." Plaintiff –

THE COURT: But can the government tell an applicant who's entitled to a patent that "We're going to hold up issuance of your patent, although we have not

looked at it. We're going to hold it up and not really give a precise reason as to why it's being held up," other than to just make a citation to a regulation, and then say to the reader, "If you can figure out which section that we're relying upon, good for you, because we're not going to tell you"? The whole thing is just (pause), *it's very troublesome.* (A769-70; emphasis added.)
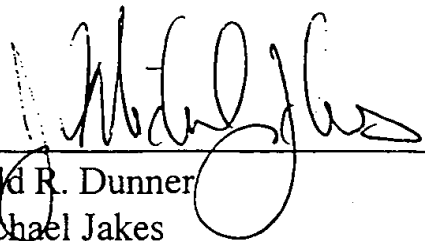
Thus, as expressed in its opinion, the district court was troubled by several steps in the PTO's process, including the withdrawal of the '294 application from issue "without the benefit and any PTO employee's re-evaluating the file." *BlackLight*, 109 F. Supp.2d at 54 n.10, 55 USPQ2d at 1820 n.10. (A25 n.10.) These concerns should have led it to the conclusion that the PTO's decision was arbitrary and capricious, a conclusion that this Court should reach on appeal.

III. CONCLUSION

For these reasons, the district court's grant of summary judgment for the Commissioner and against BlackLight should be reversed. The case should be remanded to the district court with instructions to set aside the PTO's illegal actions in withdrawing BlackLight's application Serial Nos. 09/009,294, 09/008,947, 09/009,455, 09/009,678, and 09/111,160, and to direct that these applications issue as patents.

Respectfully submitted,

Dated: February 20, 2001

By:_____

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CERTIFICATE OF SERVICE
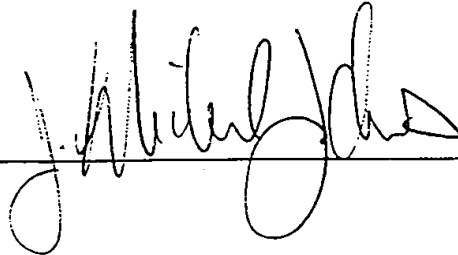
I certify that two true copies of the foregoing REPLY BRIEF FOR PLAINTIFF-APPELLANT BLACKLIGHT POWER, INC., were served by first class mail on February 20, 2001, on counsel for Defendant-Appellee as follows:

> John M. Whealan
> Solicitor
> U.S. Patent and Trademark Office
> P.O. Box 15667
> Arlington, Virginia 22215

_____

CERTIFICATE OF COMPLIANCE

I certify that the foregoing REPLY BRIEF FOR PLAINTIFF-APPELLANT BLACKLIGHT POWER, INC., contains 6541 words as determined by WordPerfect 8.0, which was used to prepare the brief.

_____

February 28, 2000

VIA HAND-DELIVERY

Ms. Esther Kepplinger
Director of Group 1700
United States Patent & Trademark Office
Washington, D.C. 20231

<div align="center">

Re: Improper Withdrawal From Issuance of
U.S. Patent Application Ser. No. 09/009,294

</div>

Dear Ms. Kepplinger:

This letter is a follow-up to our telephone conversations of last week concerning recent actions taken by the U.S. Patent and Trademark Office, which, as indicated in the attached February 17, 2000 Notice from the Office of Petitions, has resulted in the withdrawal from issuance of Patent Application Ser. No. 09/009,294. This application was due to issue as U.S. Patent No. 6,030,601 on February 29, 2000.

As I understand it, these actions were based on U.S. Patent Office concerns that the technology developed by inventor Dr. Randell L. Mills and disclosed in the subject patent application, and perhaps in other allowed applications and a prior issued patent of Mills, represents "unproven science," such as "cold fusion." I am writing to allay those concerns and to assure you that they are unfounded inasmuch as this technology has been subject to extensive testing and proven beyond argument to work. The results of that testing have already been presented and positively considered by the U.S. Patent Office and embraced by highly reputable companies, not to mention the U.S. Navy and the American Chemical Society.

Before proceeding any further, let me just say that I appreciate the courtesy you extended in taking my calls inquiring into this matter and the circumstances surrounding this rather unusual turn of events. I gathered from your comments that you share my desire to resolve this matter as directly and expeditiously as possible, and it is my sincere hope that this letter, as the first step in that process, will convince you that there is no need for further examination of the '294 patent application and that it should be immediately allowed to issue.

As I stated during our conversations, this application, as well as the other allowed Mills applications assigned to my client, Blacklight Power Inc., represents a significant advance in the

chemical arts. The underlying technology disclosed in these applications is the culmination of over ten years of research and the expenditure of over ten million dollars invested by well-known companies, such as AMP Corporation, Connectiv, and PacificCorp, companies that would not dare risk their business reputations on "unproven science."

To be sure, Dr. Mills' technology has undergone rigorous testing by over 25 well-known independent laboratories and has been shown to be based on sound scientific principles and, more importantly, shown to work precisely as described in Mills' '294 patent application. Based on his startling discoveries, Dr. Mills was bestowed the honor of addressing the October 1999 meeting of the American Chemical Society (ACS) in California, during which he presented to an enthusiastic and receptive audience the test results for the very compounds disclosed and claimed in that application. Also a featured speaker at this meeting was Dr. Johannes Conrads, retired Director and Chairman of the Board of the Institute for Low Temperature Plasma Physics at Ernst Moritz Arndt University in Greifswald, Germany. Dr. Conrads, considered by many to be one of Germany's top physicists, tested the Mills technology himself and reported to the ACS that it produced an energetic plasma in hydrogen with no power input, conclusively demonstrating a new source of chemical energy from hydrogen never before seen. Dr. Conrads, and the four other top scientists who assisted in this testing, would not put their professional reputations in jeopardy for the sake of "unproven science."

These positive test results also have not escaped the attention of the U.S. Government. Following a thorough review, the United States Navy has taken affirmative steps to develop applications based on the Mills technology in cooperation with Blacklight Power.

In view of the allowance of this and other patent applications of Dr. Mills, the issuance of U.S. patent No. 6,024,935 to Dr. Mills, and other highly-desirable commercial applications of the Mills technology, Blacklight Power's management has committed to the process of going public and has limited its choice of underwriter to either Morgan Stanley or Goldman Sachs, two of Wall Street's top investment firms who also share an interest in carefully guarding their business reputations. Indeed, this process is now in the latter stages, with the filing statement for the IPO scheduled for late March. The market capitalization for this public offering is expected to exceed one billion dollars based on current market conditions. Blacklight Power's current private market capitalization is already in excess of 340 million dollars, based on the last private placement that was oversubscribed.

This enthusiastic public response to Blacklight Power and the revolutionary technology it developed did not just happen by chance. The company has been built upon a rock solid foundation of top-notch scientists and leaders in chemistry and physics. Included among the distinguished board members of Blacklight Power are: Dr. Shelby T. Brewer, M.S. and PhD. degrees from MIT in Nuclear Engineering, former Assistant Secretary of the Department of Energy and former Chief Executive Officer of Combustion Engineering's Nuclear Business; George A. Sawyer, former Assistant Secretary of the Department of Navy; David Blake presently with Connectiv and formerly a top manager with Du Pont and Hurcules Chemical Specialties

Company; and Michael P. Kalleres, former President and CEO of Global Associates, Ltd., Technology Services Group, and retired Vice Admiral from the U.S. Navy, currently serving on the Defense Science Board, the Naval Studies Board of National Academy of Science, and the Dean's Advisory Council of Purdue University. Furthermore, many of the shareholders of Blacklight Power are Phd. chemists and physicists. Certainly, the U.S. Patent Office does not believe that this impressive list of PhD. chemists and physicists associated with Blacklight Power would waste their money and efforts on "unproven science."

No doubt, therefore, you can appreciate the significant negative impact the PTO's withdrawal of the '294 patent application from issuance has had not only on Blacklight Power, but on many other players in the industry, including the U.S. Government, who have a vested interest in seeing that the Mills technology is not just commercially developed, but also adequately protected against piracy. Thus, you can understand my utter dismay when you informed me that this application had been "pulled" based on some perceived "heat" (from an undisclosed source) without reviewing the file history. As with any revolutionary technology, such negative reactions should not be surprising and, indeed, should be expected. I would hope that the Patent Office would not act "willy-nilly" upon some unfounded conclusions drawn without adequate evidentiary basis.

I was also disturbed by Director Robert Spar's comment to me that he directed Petitions Examiner Frances Hicks to issue the petition to withdraw the subject patent application from issuance based on the premise that the underlying technology involved "cold fusion." With all due respect, that assertion is baseless and utter nonsense since the subject patent application is directed to chemical compositions of stable matter rather than a nuclear reaction process. The distinction between stable chemical compounds and a nuclear reaction process should be obvious to any competent chemist and such a determination was in fact made by the U.S. Patent Office.

One such competent chemist, Primary Examiner Steven Kalafut, evaluated over 130 published "cold fusion" articles during prosecution of the subject patent application, as evidenced by the extensive initialed Form PTO/SB/08A and B documents, and it was certainly clear to him that the subject application is not related to cold fusion. Examiner Kalafut was advised by the undersigned during a personal interview that these immaterial "cold fusion" publications were being submitted in the subject application only because they were previously cited by Examiner Harvey Behrend of Group 3641 in an earlier application by Dr. Mills. Steven Kalafut also withdrew a Section 101 rejection of the subject application based on inoperability after Dr. Mills personally submitted convincing experimental evidence by unbiased third party physicists and chemists that the subject patent application is operable.

Another competent chemist, Primary Examiner Wayne Langel, also examined the over 130 published "cold fusion" articles during prosecution of another patent application and allowed that application to issue as U.S. Patent No. 6,024,935. Examiner Langel was also advised by the undersigned during a personal interview that these immaterial "cold fusion" publications were

being submitted only because they were previously cited by Examiner Harvey Behrend of Group 3641 in an earlier application by Dr. Mills.

The '935 patent, prior to issuance, is believed to have been subject to another level of review and approved by the Office of Patent Quality Review. This belief is based on the fact that the application was sent back to Examiner Langel to correct a very minor mistake in claim 304, line 1 to replace "304" with - - 303 - - after the application was forwarded to the Patent Publication Branch. Furthermore, the patent issued more than ten months after payment of the issue fee, allowing more than sufficient time for U.S. Patent Office to review the '935 patent before issuance.

I must say that I was also somewhat taken aback by your statement that you had no evidence that the invention disclosed in the subject '294 application was inoperable. In spite of this lack of evidence, you also stated that you believed the invention was inoperable because you learned in a textbook that "atomic hydrogen" cannot go below the "ground state." We acknowledge that atomic hydrogen having the ground state of 13.6 eV can only exist in a vacuum or in isolation, and that atomic hydrogen cannot go below this ground state in isolation. However, please keep in mind that there is no known composition of matter containing hydrogen in the ground state of 13.6 eV. When hydrogen reacts with another element, it goes to a lower energy state. Dr. Mills has discovered new compositions of matter containing hydrogen at new lower energy levels, which lower energy levels are achieved using the novel catalysts disclosed in the subject patent application. Over forty new compounds have been produced using Dr. Mills technology which exhibit novel, commercially valuable properties. The existence of the new lower energy level hydrogen has been established by well known analytical chemistry methods including Nuclear Magnetic Resonance Spectroscopy, Time of Flight Secondary Ion Mass Spectroscopy, and X-Ray Photoelectron Spectroscopy conducted by unbiased third parties. Primary Examiners Kalafut and Langel have fully evaluated this extensive experimental data.

To distinguish the new lower energy level hydrogen from conventional energy level hydrogen, Dr. Mills has named the new lower energy level hydrogen "hydrinos." "Hydrino" is latin for smaller or tighter bound hydrogen. The subject patent application describes and claims novel chemical compositions of matter comprising hydrinos. Please be assured that absolutely no nuclear "cold fusion" reactions are occurring in the formation of the hydrinos.

The U.S. patent system worked precisely as intended in the issuance of U.S. Patent No. 6,024,935 and the Notice of Allowances in five U.S. patent applications of Dr. Mills, including the subject application. The issued '935 patent and the five allowed patent applications were objectively and fairly examined by experienced Primary Examiners Kalafut and Langel on all of the surrounding facts, including "cold fusion" accusations. When I inquired about the '935 patent and these other allowed applications, Director Spar also informed me that the '935 patent will most likely be Reexamined by the U.S. Patent Office and petitions for withdrawal from issuance will be filed in the other four allowed applications of Dr. Mills. To overturn the objective examination of these applications by two experienced, chemical Primary Examiners
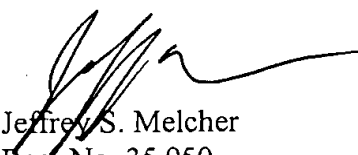
based on a whim and unsubstantiated "cold fusion" accusations by unnamed parties undermines the integrity of the U.S. Patent Office and, indeed, the entire U. S. patent system.

In an effort to better understand the underlying basis for the PTO's actions and to bring this matter to a swift conclusion, we respectfully request a meeting with you and whoever else you deem to be appropriate, to discuss this matter further before any Office Actions are issued in the subject '294 patent application or in any other presently allowed application, and before any Reexamination of the '935 patent that would drag this matter out before the public.

Since the U.S. Patent Office was unable to locate a copy of the prosecution history for the subject patent application as of February 25, 2000, more than one week after Ms. Hicks signed the petition, we have enclosed a courtesy copy of our prosecution file history for your review in this matter.

Thank you for your attention to this matter and we look forward to your prompt reply.

Sincerely yours,

Jeffrey S. Melcher
Reg. No. 35,950
Tel. No.: 202.261.1045

Attachments

Cc: The Honorable Todd Dickinson - Commissioner of Patents
     Robert Spar - Director of Special Programs
     Francis Hicks - Petitions Examiner
     Stephen Kalafut – Primary Examiner Group 1700
     Wayne Langel – Primary Examiner Group 1700

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FARKAS & MANELLI PLLC
ATTORNEYS

January 19, 2001

VIA COURIER
Ms. Esther Kepplinger
Director of Group 1700
United States Patent & Trademark Office
Washington, D.C. 20231

      Re: U.S. Patent Application Serial Nos.: 09/009,837; 09/008,947; 09/009,294;
           09/009,455; 09/110,678; 09/111,160; 09/111,003; 09/501,622;
           09/110,694; 09/110,717; 09/225,687; and 09/362,693
           Inventor: Dr. Randell L. Mills
           Examiners: S. Kalafut and H. Langel

Dear Ms. Kepplinger:

This letter is to advise you that Dr. Mills has arranged for a personal interview with Examiners Kalafut and Langel for February 21, 2001, 10:00 AM, to discuss outstanding Office Actions in all of the above-identified patent applications. Since all of the applications contain similar rejections under 35 U.S.C. §§ 101 and 112 based on issues relating to quantum mechanics, in particular the Schrodinger Equation, the Examiners and Dr. Mills have agreed that it would be prudent to conduct the interview simultaneously in all applications. To assist Dr. Mills in adequately preparing for this interview, we request that the Patent Office provide certain information as detailed below, which frankly should have been disclosed to Dr. Mills long ago. We also request the presence of certain Patent Office personnel, including yourself, at the February 21st interview to facilitate a prompt resolution of all outstanding issues.

As you are no doubt aware, the Patent Office's position as to the patentability of Dr. Mills' technology has changed radically over the last year. Initially, during our February 28, 2000 discussion, you stated that our '294 application was being withdrawn from allowance because Dr. Mills' technology was based on "cold fusion" and "perpetual motion." Only after Dr. Mills took this matter to a federal district court did the Patent Office abruptly alter its position. According to the March 22, 2000 Decision on Petition filed in that case, the '294 application was withdrawn because Dr. Mills' technology supposedly violated "the laws of chemistry and physics," even though no specific law of chemistry or physics was identified.

In the most recent Office Actions entered in the above-identified applications, the Patent Office once again has changed its position. The Patent Office now argues that Dr. Mills' technology cannot exist because it is not in compliance with the Schrodinger Equation, which is neither a law of physics or chemistry. In support of its new position, the Patent Office argues that "[n]ot every mathematically possible solution to the Schrodinger Equation leads to a physically meaningful description."[1] That argument, however, only begs the question: How can one know which solutions of the Schrodinger Equation represent physical reality other than by actual measurements of hydrogen atoms?

Dr. Mills has now found additional solutions to the Schrodinger Equation that represent physical reality, namely, fractional quantum number states, which are supported by actual measurements of newly-created compounds containing hydrogen atoms at these lower-energy states. Examiners Kalafut and Langel extensively studied this experimental data during six personal interviews and, based on this evidence, allowed five of the above-identified applications (now withdrawn) and issued U.S. Patent No. 6,024,935 ('935 patent). Dr. Mills intends to resubmit this substantial experimental evidence in the February 21[st] interview, as well as recent experimental evidence, to again establish the existence of these lower energy states to the satisfaction of the Patent Office, and thereby demonstrate the utility and enablement of his invention.

Based on the prior representations of Examiners Kalafut and Langel - - who exhaustively examined the applications and, believing that the claimed technology fully complies with Sections 101 and 112, allowed six of them - - it was readily apparent that neither Examiner of record drafted the newly-minted Section 101 and 112 rejections now pending in the above-identified applications. Recent conversations with Examiners Kalafut and Langel confirmed that belief as I became aware that the Section 101 and 112 rejections were drafted by a "secret committee" of Examiners, Supervisors and Directors established to conduct a "behind the scenes" prosecution of the above-identified applications. I further learned that this secret committee instructed Examiners Kalafut and Langel to issue the Office Actions containing the Section 101 and 112 rejections. While the Office Actions fail to identify the make-up of the committee, I am aware of at least the following committee members:

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[1]Dr. Mills' PCT/US99/17129, International Preliminary Examination Report, Response to Applicant's Arguments Concerning the Written Opinion.

Examiner Vasudevan Salem Jagannathan
Examiner Suzi N. Tsang
Examiner Jerome Massie
Examiner Steven P. Griffin
Director Jacqueline M. Stone

Examiners Langel and Kalafut further informed me that they believe Examiner Jagannathan, a physicist, was the committee member who provided the most input on the Section 101 and 112 rejections. Upon learning this, I telephoned Examiner Jagannathan on January 16, 2001 to discuss his availability to attend the February 21st interview and to inquire as to the type of experimental evidence that would be required to satisfy him that Dr. Mills' technology is fully operable. I must say, I was stunned by Examiner Jagannathan's reaction to my call. He immediately raised his voice and in a very stern manner steadfastly refused to answer any questions or provide me with any information since, in his words, he is not the Examiner of record. Examiner Jagannathan further stated that only Examiners Langel or Kalafut could request his presence at the interview, without providing any assurance that he would comply with such a request.

It is bad enough that Examiner Jagannathan offered no explanation as to why he was not identified as an Examiner of record in this case based on the input he provided on the pending Office Actions. It only makes matters worse that he would use his non-record status as an excuse to withhold information that is vital to Dr. Mills prosecuting his applications.

Clearly, an interview with just Examiners Langel and Kalafut in attendance would be non-productive, since they both already believe that the applications fully comply with Sections 112 and 101 and, therefore, should be allowed. In essence, the Patent Office is requesting that we conduct a sham interview with what the Patent Office perceives to be "puppet" Examiners who did not even write, and disagree with, the rejections and without knowing the type of experimental evidence that would satisfy the concerns of the secret Examiners who are "pulling the strings." Dr. Mills has already submitted evidence relating to energy balances, heat and light data from working processes, and spectral data from compounds containing the lower-energy hydrogen atoms, including nuclear magnetic resonance spectroscopy, time-of-flight-secondary-ion-mass-spectroscopy, and X-ray photoelectron spectroscopy. It was precisely this evidence that convinced the Examiners of record to allow six of Dr. Mills' applications. Unfortunately, it appears that the Patent Office is not really interested in a fair and open discussion of the evidence, but rather, is seeking to "deep-six" Dr. Mills' technology along with the patent rights to which he is entitled.

FARKAS & MANELLI

The formation of a secret committee allied against Dr. Mills is just another example of the extreme lengths to which the Patent Office has gone to subvert issuance of Dr. Mills' patent applications. This latest action is consistent with the extreme positions the Patent Office has taken in litigation over the previously allowed applications that were withdrawn without the slightest review under mysterious circumstances. Indeed, Kevin Baer, the Patent Office's counsel, went so far as to argue to a federal judge that Examiners Kalafut and Langel allowed the six applications because they were "swamped" and "if they're going to approve it, they just approve it and kind of let it out the door." Attachment A. This argument not only repudiates the presumption of validity that attaches to issued patents, but further overlooks the fact that six lengthy personal interviews with Examiners Langel and Kalafut were conducted, during which extensive experimental results were discussed.

Strangely, Mr. Baer also argued that Dr. Mills is not qualified to invent the subject technology because he is a medical doctor, overlooking the fact that he is an accomplished chemist, and further that "[i]f someone actually invents this, assuming Dr. Mills has not invented this, if someone comes along and invents it in the future, they could be blocked by a valid patent [referring to Dr. Mills issued '935 patent]." Attachment B. This argument confirms Dr. Mills' strong suspicion that the Patent Office has been colluding with competitors of Dr. Mills', including Dr. Robert Park of the American Physical Society, who may be trying to appropriate Dr. Mills' technology. Dr. Mills has learned - - and the Patent Office has been made aware - - that there is a "deep throat" contact in the Patent Office with whom Dr. Park has had communications regarding Dr. Mills' pending patent applications. This fact, which was first brought to the attention of the Patent Office over four months ago during the litigation and to this day has not been denied. Attachment C.

In view of the above circumstances and in the interest of fairness, Dr. Mills requests a full written disclosure of all U.S. Patent Office personnel who took part in preparing the Section 101 and 112 rejections, as well as all U.S. Patent Office personnel who provided any input regarding the Office Actions in the above-identified applications. We request that all such persons be present at the February 21st interview. We also request that all members of the secret committee be identified and be present at the interview so that we can address any and all concerns of those who will actually decide the fate of the pending applications.

Dr. Mills has been made aware that the above-identified applications may have been reviewed by an unnamed "consultant" from the National Institutes of Science and Technology (NIST). Dr. Mills also requests full and fair written disclosure of all non-Patent Office personnel, including personnel from NIST, who were provided access to any of the above-identified applications and/or provided input on the Office Actions.

We ask that you also be present at the interview, as we would like to revisit the question of who was responsible for bringing Dr. Mills' '935 patent to the Patent Office's attention, thereby setting in motion the events that led to the withdrawal of Dr. Mills' allowed applications. You and the Patent Office have now taken three conflicting positions on this issue: (1) you stated to me on February 28, 2000 that you pulled the applications from issuance based on perceived heat - - a "fire storm" as you put it - - the Patent Office had received from an undisclosed, outside source in response to the issuance of the '935 patent, and that it was Gregory Aharonian who brought the '935 patent to the attention of the Patent Commissioner; (2) you stated in a signed affidavit filed with the D.C. District Court that your decision to withdraw the applications was not based on any "perceived heat the USPTO has received from an undisclosed, outside source," Attachment D; and (3) subsequently, the Patent Office's counsel argued during the May 22, 2000 hearing that he did not know how you became aware of the '935 patent, suggesting that a blimp could have flown over the Patent Office advising you of the '935 patent, for all it mattered, and then abruptly changed his position a short while later in a brief to the D.C. District Court stating that the press initiated the withdrawal of the applications, Attachment E. We would like to hear from you first hand, on the record, as to which individual(s) contacted you or other Patent Office personnel and instructed, or otherwise precipitated in, the withdrawal of the applications from issuance.

We believe that we are entitled to this information and that previous attempts to keep it secret - - even in response to two previous Senate inquiries - - are without basis. This information is not attorney-client privileged, nor the subject of any issue to be resolved in the pending litigation. Indeed, both the Patent Office and Dr. Mills have stipulated that information as to how the Patent Office became aware of the issued '935 patent that caused you to withdraw Dr. Mills' allowed applications from issuance is immaterial to the lawsuit. Furthermore, the Patent Office's argument that prosecution of the withdrawn applications should be separate and distinct from the lawsuit as a procedural matter, and its reopening of prosecution in these applications brings to the forefront questions regarding who instigated the taking of such actions, the real parties prosecuting the applications on behalf of the Patent Office, and the extent of any outside influences on the prosecution of these applications. This information has a direct bearing on the fair and open prosecution of these applications and, therefore, it must be disclosed.
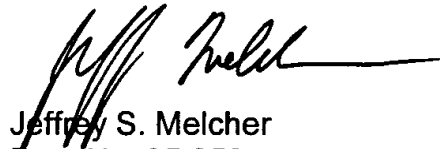
Please also be advised, that due to the unusual actions the Patent Office has taken with respect to Dr. Mills' applications, as well as the significant impact of Dr. Mills' technology on U.S. energy policy, we intend to have one or more U.S. Senators and/or Government Officials be made of record in the applications and attend the interview to monitor the situation.

I look forward to your prompt written response to this letter.

Sincerely yours,

Jeffrey S. Melcher
Reg. No. 35,950
Customer No. 20736

CC: The Honorable Senator Max Cleland
The Honorable Senator Arlen Specter
Transition Office - Energy Department
Transition Office - Commerce Department
The Honorable Secretary Designate of Commerce - Don Evans
Examiner Vasudevan Salem Jagannathan
Director Jacqueline M. Stone
Examiner Suzi N. Tsang
Examiner Jerome Massie
Examiner Steven P. Griffin
Examiner Wayne A. Langel
Examiner Steven J. Kalafut
Dr. Randell L. Mills

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

BLACKLIGHT POWER, INC.	)	C.A. NO. 00-422(EGS)
	)	
VS.	)	WASHINGTON, D.C.
	)	MAY 22, 2000
Q. TODD DICKINSON	)	10:00 A.M.

TRANSCRIPT OF MOTIONS HEARING

BEFORE THE HONORABLE EMMET G. SULLIVAN

UNITED STATES DISTRICT JUDGE

APPEARANCES:

FOR THE PLAINTIFF: MICHAEL H. SELTER, ESQ.
                         JEFFREY A. SIMENAUER, ESQ.
                         JEFFREY S. MELCHER, ESQ.

FOR THE DEFENDANT: FRED E. HAYNES, ESQ.
                         KEVIN BAER, ESQ.

COURT REPORTER: FRANK J. RANGUS, OCR
                         U. S. COURTHOUSE, RM. 6822
                         WASHINGTON, D.C. 20001
                         (202) 371-0545

PROCEEDINGS RECORDED BY ELECTRONIC STENOGRAPHY; TRANSCRIPT
PRODUCED BY COMPUTER.

1   FORM AND A PATENT COULD ISSUE WITHOUT ANY MEANINGFUL REVIEW?

2   MR. BAER: WELL, NO, YOUR HONOR, THERE IS REVIEW. THE

3   PATENT EXAMINERS DO REVIEW THEM. UNFORTUNATELY, PATENT

4   EXAMINERS ARE SWAMPED AND SOMETIMES THINGS SLIP THROUGH. IN

5   THIS CASE, AT LEAST THE APPLICATION AT ISSUE IN THIS SUIT, IT

6   DOESN'T APPEAR THAT THE EXAMINER DISCUSSED THE FRACTIONAL

7   QUANTUM NUMBERS. NOW, PLAINTIFF WILL ARGUE THAT THEY DID, BUT

8   I CAN'T FIND ANYTHING IN THE RECORD WHERE THEY DISCUSSED A

9   FRACTIONAL END NUMBER. THAT'S THE QUANTUM NUMBER.

10   UNFORTUNATELY, THE ONE THAT ISSUED GOT THROUGH. BUT HERE WE

11   HAVE BEEN ABLE TO TAKE A SECOND LOOK AT IT AND WE HAVE SERIOUS

12   QUESTIONS ABOUT THE PATENTABILITY, AND WE DON'T WANT TO ISSUE

13   AN INVALID PATENT.

14   THE COURT: IF THE COURT AGREES WITH THE GOVERNMENT

15   THAT THE PATENT SHOULD NOT ISSUE, THERE ARE ADMINISTRATIVE

16   REMEDIES AVAILABLE TO THE PLAINTIFF?

17   MR. BAER: OH, ABSOLUTELY, YOUR HONOR.

18   THE COURT: THIS IS NOT A REJECTION. THIS IS MERELY

19   WHAT?

20   MR. BAER: IT'S A PROCEDURAL TOOL TO ALLOW EXAMINATION

21   TO CONTINUE. WHAT COULD HAPPEN, PLAINTIFF KEEPS TELLING US

22   THAT THEY'LL COME IN THE OFFICE AND THEY'LL PROVE IT'S

23   PATENTABLE, AND IF IT IS PATENTABLE, WE WILL ISSUE IT.

24   THE COURT: SO IT'S NOT AS IF THE PLAINTIFF IS OUT OF

25   COURT?

1   THE COURT: THEY'RE SO NOVEL THAT THEY REQUIRE

2   INVESTMENTS OF TIME, SIGNIFICANT INVESTMENTS OF TIME, TO

3   DETERMINE WHETHER OR NOT THEY ARE PATENTABLE, I ASSUME.

4   MR. BAER: THAT IS CORRECT, YOUR HONOR.

5   THE COURT: WHAT HAPPENED IN THIS CASE? THIS PATENT

6   WAS FILED A COUPLE OF YEARS AGO. IT LOOKS LIKE EVERYONE FELL

7   ASLEEP AT THE SWITCH UNTIL AFTER ONE PATENT WAS ISSUED AND THAT

8   TRIGGERED THIS. AFTER THE 935 PATENT WAS ISSUED, THEN THAT

9   TRIGGERED ALL SORTS OF SCRUTINY FOR THE 294.

10   MR. BAER: YOUR HONOR, IT IS FILED. THE EXAMINER

11   LOOKS AT IT. I BELIEVE THE EXAMINER ONLY HAS, IT IS LESS THAN

12   A WEEK, AND I BELIEVE THEY HAVE TO LOOK AT TWO OR THREE

13   APPLICATIONS A WEEK. SO VERY LITTLE TIME ACTUALLY WAS SPENT

14   LOOKING AT THIS APPLICATION. SO THE EXAMINER ISSUED SOME

15   OFFICE ACTIONS. IT WENT BACK AND FORTH AND EVENTUALLY HE

16   ALLOWED IT, BUT THERE WAS NOT A TWO-YEAR INVESTIGATION OF THIS.

17   YOU HAD ALSO ASKED, HAD THE OFFICE RUN ANY TESTS? WE

18   DON'T HAVE ANY ABILITY WITHIN THE AGENCY TO RUN THE TESTS.

19   THAT'S WHY WE WANT THE APPLICANT TO COME IN. AND ONCE AGAIN I

20   HAVE TO REMIND YOU THEY REQUESTED TO COME IN IN THEIR FORMAL

21   LETTER TO THE AGENCY: "LET US COME IN AND TALK TO YOU ABOUT

22   THIS BEFORE YOU DO ANYTHING." WE AGREED TO THAT. THEY'VE NOW

23   BACKED AWAY FROM THAT.

24   THE COURT: WHAT'S THE PREJUDICE TO THE GOVERNMENT IF

25   THIS PATENT ISSUES? I MEAN, THE PLAINTIFFS MAINTAIN IT WILL DO

1 ATTENTION TO THAT. THE PATENT NEVER ISSUED. NOW, NOT ALL OF

2 THOSE ARE FOR THIS REASON. SOME WOULD BE FOR INTERFERENCES.

3 SOME WOULD BE AT THE APPLICANT'S REQUEST. BUT IT'S NOT AN

4 UNCOMMON OCCURRENCE THAT THE AGENCY, AFTER THE ISSUANCE FEE IS

5 PAID, FINDS SOME REASON TO WITHDRAW THE PATENT.

6 THERE'S ALSO USUALLY A TIME LAG BETWEEN WHEN THE

7 NOTICE OF ALLOWANCE GOES OUT AND THE ISSUE FEE IS PAID, AND IN

8 THESE CASES THE ISSUE FEE IS PAID WITHIN DAYS. NOW, THAT'S NOT

9 TO SAY IT NEVER HAPPENS, AND MAYBE THAT'S THIS FIRM'S PRACTICE,

10 TO DO IT ALL THE TIME. IN MOST OF THE CASES I'VE SEEN, THERE'S

11 ALWAYS A LONG DELAY.

12 THE COURT: WAS THAT A SIGNIFICANT SUM OF MONEY?

13 MR. BAER: I BELIEVE IT'S AROUND A THOUSAND DOLLARS.

14 THE COURT: A THOUSAND DOLLARS. ALL RIGHT.

15 MR. BAER: IT'S NOT THAT SIGNIFICANT FOR A

16 CORPORATION.

17 THE COURT: IS IT SIGNIFICANT THAT, WHEN THE

18 APPLICATION FOR THE PATENT WAS APPROVED, THERE WERE NO REASONS

19 GIVEN? IS THAT USUAL OR NOT?

20 MR. BAER: THAT OFTEN HAPPENS ALSO, YOUR HONOR. THE

21 EXAMINERS ARE UNDER TREMENDOUS PRESSURE TO PRODUCE WORK, AND IF

22 THEY'RE GOING TO APPROVE IT, THEY JUST APPROVE IT AND KIND OF

23 LET IT OUT THE DOOR. SOMETIMES, THEY DO PROVIDE REASONING, BUT

24 OFTEN THEY DON'T. IT IS NOT THAT SIGNIFICANT.

25 YOUR HONOR, IF THE COURT DECIDES THAT THE AGENCY HAS

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

BLACKLIGHT POWER, INC.,   )
)
          Plaintiff,   )
)
     v.   )
)   Civil Action No. 00-00422 EGS
Q. TODD DICKINSON,   )
  Commissioner of Patents,   )
  United States Patent   )
  & Trademark Office,   )
)
          Defendant.   )
)

DEFENDANT'S MOTION FOR SUMMARY JUDGMENT

Pursuant to Fed. R. Civ. P. 56, defendant, by his undersigned attorneys, hereby moves this

Court for an order granting summary judgment in his favor on the grounds that no genuine issue

as to any material fact exists and that defendant is entitled to judgment as a matter of law. In

support of this motion, the Court is referred to the accompanying memorandum of points and

authorities and to the accompanying statement of material facts as to which there is no genuine

issue. A draft order reflecting the requested relief is also attached.

Respectfully submitted,
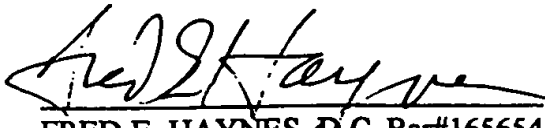
WILMA A. LEWIS, D.C. Bar#358637
United States Attorney

MARK E. NAGLE, D.C.Bar #416364
Assistant United States Attorney

FRED E. HAYNES, D.C. Bar#165654
Assistant United States Attorney

OF COUNSEL:

KEVIN BAER
MARSHALL HONEYMAN
ERIC GRIMES
Associate Solicitors
Office of the Solicitor
U.S. Patent and Trademark Office
Arlington, Virginia

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neither arbitrary nor capricious. Plaintiff's '294 application is based on theories that are not generally accepted by the scientific community. The determination that one or more claims may be unpatentable is reasonable in light of the extraordinary claims asserted by plaintiff. *In re Chilowsky*, 229 F.2d 457, 462 (CCPA 1956) (alleged inventions that conflict with recognized scientific principles are required to overcome presumption of inoperativeness).

Plaintiff's description of its invention as "conductive, magnetic plastics that will revolutionize circuitry and aerospace engineering" (Complaint ¶ 9), as capable of providing a small battery charged to move an automobile 1000 miles at highway speeds without the use of fossil fuels (Complaint ¶ 9), and as "revolutionary technology" (Exhibit 9 at 3) provide further support for the Director's decision to reopen prosecution to ensure that a potentially invalid patent does not issue. These alleged accomplishments are astonishing by themselves, but when coupled with a new theory of quantum mechanics that allegedly is based on a medical doctor/ inventor deriving a new atomic theory that unifies Maxwell's Equations, Newton's Laws, and Einstein's General and Special Relativity (Ex. 2 at col.4) , the combination provides ample reason for the USPTO to review the question of patentability.

As detailed in the accompanying statement of facts, the generally accepted understanding of the hydrogen atom is that its "ground state" is its lowest energy level and that its single electron can exist only with whole integer quantum numbers. (Ex. 1 at 210-11). In contrast to the conventional understanding of quantum mechanics, plaintiff believes that it can stimulate the hydrogen atom to go below its "ground state" and that fractional quantum numbers are possible for the hydrogen atom. These assertions are not known to the Group Director charged with examining this technology as generally accepted in the scientific community. (Ex. 5 at 5-6)

14

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

BLACKLIGHT POWER, INC.   )   C.A. NO. 00-422(EGS)
)
VS.   )   WASHINGTON, D.C.
)   MAY 22, 2000
Q. TODD DICKINSON   )   10:00 A.M.

TRANSCRIPT OF MOTIONS HEARING

BEFORE THE HONORABLE EMMET G. SULLIVAN

UNITED STATES DISTRICT JUDGE

APPEARANCES:

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                       JEFFREY S. MELCHER, ESQ.

FOR THE DEFENDANT: FRED E. HAYNES, ESQ.
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                       WASHINGTON, D.C. 20001
                       (202) 371-0545

PROCEEDINGS RECORDED BY ELECTRONIC STENOGRAPHY; TRANSCRIPT
PRODUCED BY COMPUTER.

1   WHAT THEY ARGUE IN THEIR BELIEFS IT'S CAPABLE OF DOING, THIS

2   DISCOVERY.

3   MR. BAER: YOUR HONOR, BECAUSE --

4   THE COURT: ARE YOU ARGUING IT'S A FRAUD ON THE

5   PUBLIC? YOU'RE NOT ARGUING THAT. YOU NEVER SAID IT WAS A

6   FRAUD.

7   MR. BAER: YOUR HONOR, IT IS NOT -- WE DON'T BELIEVE

8   IT'S A VALID (PAUSE) -- IT'S NOT PATENTABLE BECAUSE IT'S NOT

9   VALID ACCORDING TO THE KNOWN RULES OF SCIENCE AND --

10   THE COURT: BUT IT'S NOT FRAUDULENT, THOUGH, IS IT?

11   MR. BAER: WELL (PAUSE) --

12   THE COURT: THAT'S NOT BEEN YOUR ARGUMENT UP TO THIS

13   POINT.

14   MR. BAER: NO, I DON'T THINK I WANT TO USE THE TERM

15   "FRAUD." DR. MILLS MAY BELIEVE HE'S INVENTED SOMETHING. WE

16   DON'T BELIEVE HE'S DONE THAT AND WE'VE ASKED HIM TO COME IN AND

17   PROVE THAT, AND THEY WILL HAVE AN OPPORTUNITY TO DO THAT. THE

18   HARM IS THAT THERE IS A PRESUMPTION OF VALIDITY ATTACHED TO AN

19   ISSUED PATENT. IT IS VERY HARD FOR A THIRD PARTY TO OVERCOME

20   THAT. THEY CAN EXCLUDE OTHERS FROM THE MARKET. IF SOMEONE

21   ACTUALLY INVENTS THIS, ASSUMING DR. MILLS HAS NOT INVENTED

22   THIS, IF SOMEONE COMES ALONG AND INVENTS IT IN THE FUTURE, THEY

23   COULD BE BLOCKED BY A VALID PATENT.

24   THE COURT: I SEE.

25   MR. BAER: SO THERE IS A HARM TO THE PUBLIC.

1   POSSIBLY DO THIS?" SO THERE'S AN EXAMPLE OF A THIRD PARTY

2   CONTACTING US, AND THERE'S NOTHING SINISTER ABOUT THAT. IT'S

3   JUST HOW THE AGENCY LEARNED ABOUT IT, AND THE REAL QUESTION WAS

4   THE DECISION, IS THE DECISION RATIONAL?

5   THE COURT: WHAT ABOUT THE REAL PREJUDICE TO THE

6   GOVERNMENT? COUNSEL MAKES A POINT. WHEN I ASKED THE QUESTION

7   BEFORE, HE SAID, WELL, THE PREJUDICE IS IF SOMEONE PRESENTS AN

8   IDENTICAL PATENT APPLICATION AND IS UNABLE TO PROVE

9   PATENTABILITY, THAT PERSON WILL BE PRECLUDED FROM RECEIVING A

10   PATENT.

11   MR. BAER: CORRECT. NOT ONLY RECEIVING A PATENT --

12   THE COURT: THE GOVERNMENT'S ARGUMENT, THOUGH, IS THAT

13   THIS INVENTION, IF IT IS ONE, CANNOT BE PATENTED BECAUSE IT'S

14   NOT FRAUDULENT, BUT IT'S NOT VIABLE?

15   MR. BAER: YOUR HONOR --

16   THE COURT: IT'S NOT TRUE? WHAT IS IT?

17   MR. BAER: -- IF THIS APPLICATION WAS THE CURE FOR

18   CANCER BUT WE DIDN'T BELIEVE THEY HAD THE CURE FOR CANCER, BUT

19   WE ISSUED IT ANYWAYS, WHEN SOMEONE COMES ALONG FIVE YEARS FROM

20   NOW WITH A CURE FOR CANCER, THEY WOULD BE PRECLUDED BY THIS

21   PATENT. PLAINTIFF COULD EXCLUDE THEM FROM THE MARKETPLACE.

22   THE COURT: RIGHT.

23   MR. BAER: YOU CAN'T PRACTICE THIS.

24   THE COURT: WHAT YOU'RE SAYING IS, THIS INVENTION

25   CONTRAVENES ALL THE KNOWN LAWS OF PHYSICS AND CHEMISTRY AND IT

1   CAN'T, IT JUST (PAUSE) -- ARE YOU SAYING IT'S NOT TRUE? IT'S

2   NOT VIABLE?

3   MR. BAER: IT IS NOT KNOWN AT THIS POINT.

4   THE COURT: NOT KNOWN AT THIS POINT. RIGHT.

5   MR. BAER: BUT THAT DOESN'T MEAN --

6   THE COURT: BECAUSE IT'S NOVEL.

7   MR. BAER: BECAUSE IT IS VERY NOVEL. IT IS

8   EXTRAORDINARILY NOVEL, AND IT'S NOT TO SAY THAT THEY HAVE NOT

9   INVENTED SOMETHING. MAYBE THEY HAVE, BUT IT NEEDS TO GO

10   THROUGH FURTHER ADMINISTRATIVE REVIEW. AND IF THEY TRULY

11   HAVEN'T DONE THIS, CREATED THIS NEW ENERGY SOURCE, BUT THEY GET

12   A PATENT, THEY CAN PRECLUDE EVERYONE ELSE FROM EVER, FOR THE

13   NEXT 17 YEARS AT LEAST, FROM PROSECUTING THIS INVENTION. SO

14   WHEN SOMEONE COMES ALONG AND INVENTS THIS TEN YEARS DOWN THE

15   ROAD, PLAINTIFF CAN SAY, "OH, YOU CAN'T DO THAT" OR "YOU HAVE

16   TO PAY ME ROYALTIES."

17   THE COURT: SO THE ANSWER TO MY QUESTION IS, THE

18   GOVERNMENT IS NOT PREJUDICED AT ALL. YOU JUST ANTICIPATE

19   PREJUDICE TO SOMEONE ELSE IN THE FUTURE IF SOMEONE ELSE IS ABLE

20   TO DEMONSTRATE THAT THE ENERGY SOURCE EXISTS.

21   MR. BAER: THE PREJUDICE WOULD ALSO BE, WE'D BE

22   ORDERED TO ISSUE A PATENT THAT WE DO NOT BELIEVE AT THIS POINT

23   IS PATENTABLE, AND THAT IT'S NOT A REGISTRATION SYSTEM AT THE

24   PATENT AND TRADEMARK OFFICE. CONGRESS HAS CHARGED THE DIRECTOR

25   WITH EXAMINING PATENT APPLICATIONS, AND THAT'S WHAT WE'RE

IN THE
UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

BLACKLIGHT POWER, INC.	)	
	)	
Plaintiff,	)	
v.	)	No. 00 0422 EGS
	)	
Q. TODD DICKINSON,	)	
Commissioner of Patents	)	
	)	
Defendant.	)	

REPLY IN SUPPORT OF
PLAINTIFF'S MOTION TO AMEND THE SCHEDULING ORDER

**I.   The Court Should Reject the Patent Office's Attempt
To Raise Issues Outside of the Administrative Record.**

Plaintiff's present Motion to Amend the Scheduling Order seeks an extension to

provide the Court sufficient time to reach a decision on the merits of the parties' pending

cross-motions for summary judgment and an opportunity for either party to move for a

stay pending any appeal that might be taken from that decision.[1] The posture of this case

awaiting summary judgment did not just happen by accident. Rather, it resulted from the

parties' negotiated settlement in which BlackLight agreed to withdraw its previously-

filed application for a temporary restraining order and preliminary injunction in exchange

---

[1] Plaintiff proposed that the stay extend ten days after any judgment to allow the losing party (whether it be Plaintiff or the Patent Office) to seek a stay pending appeal. The extra ten days was for both parties' convenience because Plaintiff believed that pending any appeal, the Patent Office would not want to be directed to issue a patent, just as Plaintiff would not want an adverse office action to issue. Thus, contrary to the Patent Office's argument (Def. Opp. 4), the extra ten days suggests nothing about Plaintiff's belief in the strength of its case.

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As previously noted in Plaintiff's patent counsel's Declaration executed on April 4, 2000, Group Director Kepplinger told him that Director Dickinson directed her to review the '294 application after he received communications from undisclosed third-party sources. Exhibit 1 to Plaintiff's Motion for Summary Judgment. Although Group Director Kepplinger did not at that time disclose the third-party source, Plaintiff has done some discovery of its own and now knows why it is no coincidence that the Patent Office relied so heavily on the statements of Dr. Park, a physicist with the American Physical Society (APS), in its March 22 Decision, as this was not the first time the two have had close ties. As the Court may recall, another physicist, Dr. Peter Zimmerman, Chief Scientist for the U.S. Department of State, published an Abstract for an upcoming speech to be delivered to the APS boasting that the State Department and the Patent Office "have fought back with success" against BlackLight. Plaintiff's Reply in Support of its Motion for Summary Judgment, at 2 n.1. In an interview with Dr. Zimmerman to find out the source of those comments, he claimed to be only a "receiver" of information, not a "donor" and that it was Dr. Park who has had contact with someone in the Patent Office that Park specifically refers to as "Deep Throat." July 10, 2000, Letter to Thomas Heinemann, Esq., from Jeffrey A. Simenauer, Esq. (Exhibit 1 hereto).

While the dispute about what led to Group Director Kepplinger's review should have no bearing on the Court's decision on the pending motions for summary judgment, it does help explain why the Patent Office is now anxiously searching for some other excuse to justify its procedural missteps.

Session J12 - FPS Awards Session-Business Meeting.
MIXED session, Sunday afternoon, April 30
101B, Long Beach Convention Center

[J12.001] Touching the Third Rail: Encounters with Pseudoscience and Pseudoscientists

Peter D. Zimmerman (United States Department of State, Washington, DC 20520)

Pseudoscience, and particularly "pseudophysics" is alive and thriving as we approach the turn of the millennium. Not only have many "inventors" of cold fusion spin-offs been making money from investors, but they and "inventors" of various kinds of "zero point energy" devices, perpetual motion machines, and other wonders such as "hydrinos" have found friends in the United States Senate. At least one Nobel Laureate in physics has come to their aid. The Web has been a powerful organizing force as well.

Some organizations, including my own Department and the Patent Office have fought back with success, but always at great cost in time and energy. Pseudophysicists and their friends have money, influence, and sometimes clout. They have not hesitated to use threats, personal attacks, and the full machinery by which government is made accountable to the public to strike at those who expose technical fraud. Encounters with pseudophysicists are like grabbing a hot wire: after the first contact it is hard to get free, and it can inflict serious injury. But you, and I, and all our colleagues in the APS must do what we can to ensure that U.S. policy is not manipulated by pseudoscience, to make certain that taxpayer money is not wasted on nonesense, and to restore public confidence in real science. This will take efforts at public education, work, and as I have learned in the last year not a little bit of courage. APS and FPS should be in the thick of the battle. This talk is an account of a year in the fray.

□ **Part J of program listing**

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LAW OFFICES OF
JEFFREY A. SIMENAUER
2000 M STREET, N.W., SUITE 700
WASHINGTON, D.C. 20036-3307
TELEPHONE: (202) 833-0806
FACSIMILE: (202) 463-0823

July 10, 2000

VIA FACSIMILE &
U.S. MAIL

Thomas Heinemann, Esq.
Attorney Advisor
United States Department of State
Office of the Legal Advisor
2201 C Street, N.W.
Washington, DC 20520

Re: BlackLight Power, Inc.

Dear Mr. Heinemann:

This letter documents separate telephone conversations we had with you and Dr. Zimmerman last Friday, July 7, 2000.

We first telephoned you after having received the June 26, 2000 letter that you transmitted from James Thessin, Deputy Legal Advisor for the Department of State. In his letter, Mr. Thessin advises that the State Department sees no basis for liability on its part in the matter involving Dr. Peter Zimmerman referred to in our prior correspondence, dated May 12, 2000. Mr. Thessin further represents that Dr. Zimmerman did not give the speech at the APS conference and, based on what Dr. Zimmerman told him, did not contact the Patent Office regarding the intellectual property rights of BlackLight Power.

Even if it were true that Dr. Zimmerman did not himself contact the Patent Office, we have good reason to believe that he knows who did. That, together with Dr. Zimmerman's Abstract of his speech at the APS conference, which boasts that the State

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Department and the Patent Office "have fought back with success" against BlackLight, certainly suggests that the State Department has played a role in this matter. The purpose of our May 12 letter was to explore the precise nature of that role and, to that end, we requested that you provide us with certain information that might lead to an amicable resolution of this matter.

Given the serious implications of Dr. Zimmerman's Abstract, and our good-faith offer to resolve this matter, we certainly expected more than the "brush off" we received from Mr. Thessin. His condescending declaration that the State Department "considers the matter to be closed," while making your position perfectly clear, simply ignores the reality and gravity of the situation and will not make it go away.

In view of that position, we specifically inquired during Friday's phone conversation with you whether anyone at the State Department was serving as counsel for Dr. Zimmerman in this matter and, if not, whether you had any objections to our contacting Dr. Zimmerman directly to confirm the statements by Mr. Thessin in his letter. You said that you had no objection to our speaking with Dr. Zimmerman since, in your words, there was no actionable matter and, therefore, no need for the State Department to provide him with counsel. When I asked you for Dr. Zimmerman's inter-office phone number where he could be reached, you said you did not have his number readily available and suggested that I retrieve it through the State Department's general information number.

Based on your response to my request to speak with Dr. Zimmerman, we immediately telephoned him to see if he would be willing to speak with us in his individual capacity in an attempt to resolve this matter amicably with him. At the very outset of our conversation, we informed Dr. Zimmerman that we had just spoken to you and that you had no objections to our calling him. We even suggested that he could check with you first before discussing the matter with us and also that he was free to consult with his own chosen representative before doing so. Dr. Zimmerman confirmed your earlier statement that he was not being represented by counsel for the State Department, or any other counsel, and we then proceeded with our conversation.

Dr. Zimmerman seemed anxious to put this matter behind him. He claimed that he was only a "receiver" of information, not a "donor," and repeated what Mr. Thessin states in his letter, namely that he did not contact anyone in the Patent Office regarding the intellectual property rights of BlackLight Power. Dr. Zimmerman also admitted that some of the information he received included e-mails from Dr. Park of the APS and that Dr. Park had told him of a contact in the Patent Office Dr. Park refers to as "Deepthroat." Unfortunately, our discussion was abruptly cut short when Dr. Zimmerman informed us that he had just received an e-mail from you advising him not to speak with us and that we would therefore have to end our conversation.

Your advice that Dr. Zimmerman cease all communications with us came somewhat as a surprise given your earlier consent to our speaking with him. In addition, your prior representations referenced in our May 12 letter that Dr. Zimmerman was acting in his individual capacity and not on behalf of the State Department regarding matters reflected in the APS Abstract would appear to be in direct conflict with your advising him on whether to communicate with us.

Be that as it may, we will certainly abide by your wishes and will have no further communications with Dr. Zimmerman on this matter until we hear from either you or him that we are again free to do so. Assuming, however, for the sake of argument only that Dr. Zimmerman was being truthful regarding his passive role in this matter, we find it incredible that you would not want to convey that information so as to put this matter behind us. Your muzzling of Dr. Zimmerman only creates a heightened suspicion that, perhaps, the State Department does indeed have something to hide and that there is a basis for liability as the APS Abstract and other evidence in our possession suggests.

Should the State Department decide to change its position and reopen this matter to consider our request for information known to be in its possession, we stand ready to take this matter up with you again. Should you decide instead to maintain your present position, giving us no choice but to secure this information through formal discovery in a legal proceeding, we are prepared to take that alternative course of action as well.

In either case, we assume you will take all necessary steps to preserve the information we are seeking, including but not limited to any e-mails or other communications Dr. Zimmerman or other State Department officials have had with Dr. Park or others regarding BlackLight's intellectual property rights. We are also particularly interested in preserving all information that may be in your possession or under your control relating to Dr. Park's "Deepthroat" contact in the Patent Office.
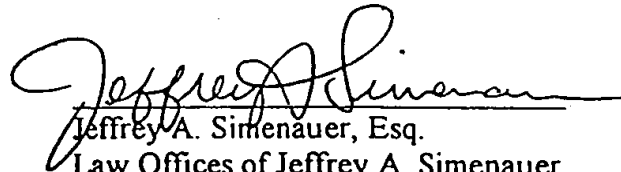
In the meantime, we have requested that Dr. Zimmerman, after further consultation with you and/or a chosen legal representative, advise us whether or not we can expect to continue our conversation to see if we can reach an amicable resolution of this matter, at least with respect to him in his individual capacity.

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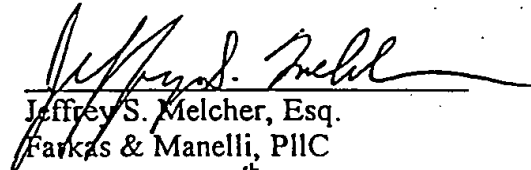
Given your instruction to Dr. Zimmerman to cease all communications with us, we kindly request that your provide a copy of this letter to him, as well Mr. Thessin. Thank you.

Sincerely,

Jeffrey A. Simenauer, Esq.
Law Offices of Jeffrey A. Simenauer
2000 M Street, 7th Floor
Washington, D.C. 20036-3307

Jeffrey S. Melcher, Esq.
Farkas & Manelli, PllC
2000 M Street, 7th Floor
Washington, D.C. 20036-3307

cc: Dr. Peter Zimmerman (via Thomas Heinemann)
    Mr. James Thessin, Esq. (via Thomas Heinemann)
    Ms. Jamison Borek, Esq.
    Dr. Shelby Brewer

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What's New
by Bob Park

The American Physical Society

Friday, 18 August 2000 Washington, DC

1. NULL HYPOTHESIS: DO ASTRONAUTS SUFFER MAGNETIC DEFICIENCY?

I must tell you, I bought a pair of Florsheim MagneForce shoes this week (WN 11 Aug 00). I have not been sick since. More on my new shoes in a later issue. Today, I want to share another Gary Null quote from the free brochure Florsheim gave me (at $125 the shoes were not free): "90-95% of health problems astronauts experienced after early space flights were eliminated when magnets were put in space suits and space capsules to counter the effects of traveling outside the earth's magnetic field." That's remarkable, since early flights never got beyond low-Earth orbit where the field is essentially unchanged. Nevertheless, we felt obliged to ask NASA. Answer: There has never been a magnet in a space suit.

2. BLACKLIGHT: SUIT AGAINST THE PATENT OFFICE FAILS.

BlackLight Power's plans to go public with an estimated $1B stock offering are presumably on hold. You may recall that on 15 Feb BLP was awarded a patent on a process for putting hydrogen atoms into a "state below the ground state," shrinking them into teeny little things called "hydrinos" (WN 18 Feb 00). A second patent dealing with hydrino chemistry was set for issuance two weeks later. But on 17 Feb the Patent Office withdrew the second patent, and opened up the first for reexamination. One patent official was concerned that the BLP technology involves perpetual motion and "cold fusion." With its intellectual property somewhere in patent purgatory, BlackLight filed suit in Federal Court against the Commissioner of Patents. Tuesday, Judge Emmet Sullivan ruled the Patent Office action was "neither arbitrary nor capricious."

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IN THE
UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

BLACKLIGHT POWER, INC. Plaintiff, v. Q. TODD DICKINSON, Under Secretary and Director of Patents Defendant.	No. 00 0422 EGS

DECLARATION OF ESTHER M. KEPPLINGER

I, Esther M. Kepplinger, declare and state:

1.   I am presently employed by the United States Patent and Trademark Office ("USPTO"), and at all times relevant to the matters contained in this declaration, I served as the Director for Technology Center 1700. If called as a witness, I would testify as follows:

2.   On Thursday, February 24, 2000, I received a call from Jeffrey Melcher, the attorney for the applicant on application 09/009,294 ("the '294 application"). Mr. Melcher indicated that he had received a Notice dated February 17, 2000 stating that the '294 application had been withdrawn from issue. I indicated to Mr. Melcher that I was the person that was responsible for the withdrawal.

3.   Four days later, Monday, February 28, 2000, Mr. Melcher came to my office. I

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explained to Mr. Melcher that I was extremely concerned about the application because it was based on the concept of an electron going to a lower orbital in a fashion that is contrary to the known laws of physics and chemistry. I also may have said that the questionable sciences alleged in patent number 6,024,035 and the '294 application were _similar_ to other questionable sciences such as "cold fusion" and "perpetual motion", but I did not tell Mr. Melcher that my concerns relating to the '294 application were based solely on the concepts of "cold fusion" and/or "perpetual motion." My main concern was the proposition that the applicant was claiming the electron going to a lower orbital in a fashion that I knew was contrary to the known laws of physics and chemistry.

4.   Mr. Melcher then questioned me as to whether Commissioner Q. Todd Dickinson was involved in the decision to withdraw the '294 application. I specifically stated to Mr. Melcher that Commissioner Dickinson had nothing to do with the initial decision to withdraw the application. I told him that I alone made the decision to withdraw the application based on patentability concerns. At no time did I tell Mr. Melcher that Commissioner Dickinson directed me or anyone else to withdraw the application from issue.

5.   .   I did not discuss my decision to withdraw the application with any person outside the USPTO. No one directed me to make the decision to withdraw the '294 application.

6.   <u>Contrary to Mr. Melcher's assertion, my decision was not based in whole or in part on any "perceived 'heat'" the USPTO had received from an undisclosed, outside source.</u>

7.   The decision to withdraw the application was based solely on the patentability standards contained in Title 35 of the United States Code.

8.   Mr. Melcher and I discussed four other applications by the same applicant that had gone to issue. I told Mr. Melcher that I was "pulling" these applications back from their locations so that I could take a look at them. I did not tell Mr. Melcher that I was going to withdraw these cases from issue. I told him that, unlike the sense of urgency regarding the '294 application, I still

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had time to obtain the other four application files for review without withdrawing them from issue. I explained that the reason I hadn't done the same with the '294 application is that it was much closer to its issue date than the other four applications.

I DECLARE UNDER PENALTY OF PERJURY UNDER THE LAWS OF THE UNITED STATES OF AMERICA THAT THE FOREGOING IS TRUE AND CORRECT.

4/14/00
Date

Esther M. Kepplinger

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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

BLACKLIGHT POWER, INC.	)	<u>C.A. NO. 00-422(EGS)</u>
	)	
VS.	)	WASHINGTON, D.C.
	)	MAY 22, 2000
Q. TODD DICKINSON	)	10:00 A.M.

TRANSCRIPT OF MOTIONS HEARING

BEFORE THE HONORABLE EMMET G. SULLIVAN

UNITED STATES DISTRICT JUDGE

<u>APPEARANCES</u>:

FOR THE PLAINTIFF: MICHAEL H. SELTER, ESQ.
                          JEFFREY A. SIMENAUER, ESQ.
                          JEFFREY S. MELCHER, ESQ.

FOR THE DEFENDANT: FRED E. HAYNES, ESQ.
                          KEVIN BAER, ESQ.

COURT REPORTER: FRANK J. RANGUS, OCR
                          U. S. COURTHOUSE, RM. 6822
                          WASHINGTON, D.C.   20001
                          (202) 371-0545

PROCEEDINGS RECORDED BY ELECTRONIC STENOGRAPHY; TRANSCRIPT
PRODUCED BY COMPUTER.

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1   SOMETHING FOCUSED HER ATTENTION ON THE 935 PATENT AND THE

2   TIMING OF THE 294 PATENT IS JUST, IT'S NOT JUST COINCIDENTAL.

3   IT WAS ABOUT TO ISSUE.

4   MR. BAER: WELL, IT WAS ABOUT TO ISSUE, YOUR HONOR,

5   BUT WHAT HAPPENED IS, I DON'T KNOW, TO ANSWER YOUR QUESTION

6   DIRECTLY, I DO NOT KNOW HOW THE DIRECTOR BECAME AWARE THAT WE

7   ISSUED A --

8   THE COURT: DOESN'T THE COURT NEED TO KNOW THAT IN AN

9   EFFORT TO DETERMINE WHETHER THE ACTIONS OF THE GOVERNMENT ARE

10 INDEED ARBITRARY AND CAPRICIOUS?

11   MR. BAER: I DON'T BELIEVE SO, YOUR HONOR, BECAUSE THE

12 ISSUE IS, IS THERE A SCIENTIFIC BASIS, A REASONABLE SCIENTIFIC

13 BASIS, TO WITHDRAW IT? AND IS THAT ARBITRARY AND CAPRICIOUS?

14 PLAINTIFF DOESN'T EVEN CHALLENGE THE REASONABLENESS. NOW, THEY

15 HAVE SOME PROCEDURAL ISSUES THEY ARGUE WITH, BUT THE ACTUAL

16 ISSUES OF THE SCIENTIFIC CONCERNS, THEY DO NOT CHALLENGE. THEY

17 ADMIT THAT THIS IS NOVEL SCIENCE, THIS IS UNKNOWN. THEY SAY IT

18 WORKS. THEY SAY IT'S DIFFERENT, THAT THEY HAVE TAKEN QUANTUM

19 MECHANICS TO A NEW LEVEL.

20   THE COURT: SO NO ONE, THE PLAINTIFFS ARE NOT ASKING

21 THE COURT TO FOCUS ON THE REASONS LEADING UP TO OR THE FACTS OR

22 CIRCUMSTANCES LEADING UP TO THE DIRECTOR'S CONSIDERATION OF THE

23 935 PATENT?

24   MR. BAER: I DON'T BELIEVE SO. THEY WITHDREW THAT.

25   THE COURT: NO ONE IS CASTING ANY SINISTER ALLEGATIONS

1 (PAUSE) --

2 MR. SELTER: WE'RE SAYING FOR PURPOSES OF THE MOTION

3 FOR SUMMARY JUDGMENT, SINCE THEY DISPUTE IT IN THEIR AFFIDAVIT,

4 WE ARE NOT RAISING THAT AS A POINT, BUT WE DO BELIEVE THAT IT

5 OCCURRED. AND SIGNIFICANTLY, I'VE YET TO HEAR FROM MR. BAER.

6 I MEAN, IT'S A FACT IT'S DISPUTED, BECAUSE WE WANT A DECISION

7 ON --

8 THE COURT: YOU CAN'T HAVE IT BOTH WAYS, COUNSEL.

9 YOU'RE NOT RAISING IT AS A POINT. CORRECT?

10 MR. SELTER: WE'RE NOT RAISING IT AS A POINT.

11 THE COURT: ALL RIGHT.

12 MR. SELTER: BUT WE WILL NEED A DECISION TO BE

13 RESOLVED FOR PURPOSES OF THE SUMMARY JUDGMENT.

14 THE COURT: I JUST WANT THE RECORD CLEAR ON THAT.

15 ALL RIGHT, THANK YOU.

16 ALL RIGHT.

17 MR. BAER: YOUR HONOR, EVEN --

18 THE COURT: IT'S NOT A POINT.

19 MR. BAER: OKAY. I WOULD EVEN SAY, YOUR HONOR, YOU

20 COULD IMAGINE IN YOUR HEAD ANY SCENARIO OF HOW WE LEARNED ABOUT

21 IT. A BLIMP FLYING OVER US. IT DOESN'T MATTER, BECAUSE WHAT

22 MATTERS, YOUR HONOR, IS THE DECISION ITSELF. IS THERE A

23 REASONABLE, NON-ARBITRARY REASON BASED ON THE SCIENCE, BASED ON

24 THE PATENTABILITY, TO WITHDRAW THIS APPLICATION FROM ISSUE?

25 THE ANSWER IS YES. PLAINTIFF DOES NOT CHALLENGE THAT.

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UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

BLACKLIGHT POWER, INC.	)	
	)	
Plaintiff,	)	Civil Action No.
	)	00 CV 0422 (EGS)
v.	)	
	)	
Q. TODD DICKINSON	)	
Director of the United States	)	
Patent and Trademark Office	)	
	)	
Defendant.	)	

DEFENDANT'S OPPOSITION TO PLAINTIFF'S
MOTION TO AMEND THE SCHDEDULING ORDER

Defendant, Q. Todd Dickinson, Director of the United States Patent and Trademark

Office ("Director"), respectfully opposes plaintiff's motion for an open-ended stay because no

further stay is warranted and any additional stay will serve as an unjustified restraint against lawful

government activity. Although plaintiff fails to ask properly for a preliminary injunction, plaintiff

is seeking, in effect, a preliminary injunction against the United States. The motion should be

denied for three independent reasons. First, plaintiff's failure to seek a preliminary injunction

under Federal Rule of Civil Procedure 65 should summarily preclude the relief requested.

Second, assuming that this Court treats plaintiff's motion to amend the scheduling order as a

proper motion for a preliminary injunction, then the motion should be denied because plaintiff has

failed to articulate any basis for a preliminary injunction. Last, if this Court reviews the merits of

a theoretical request for a preliminary injunction, then a preliminary injunction should be denied

1

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Withdrawal occurred after the press brought the subject matter of the issued patent to the attention of USPTO management officials after the issuance of plaintiff's patent.[12] These additional factors weigh against granting the extraordinary relief of enjoining the United States from further examining the pending patent application.

Conclusion

"[I]njunctive relief is an 'extraordinary remedy.'" *DynaLantic Corp.* 937 F. Supp at 11 Plaintiff has provided no basis for restraining the United States from taking lawful and regular government action. *See Waldman Publishing Corp. v. Landoll, Inc.*, 43 F.3d 775, 785 (2nd Cir. 1994) ("Injunctive relief should be narrowly tailored to fit specific legal violations."). Plaintiff has wholly failed to articulate reasons under the standard four-part test for determining preliminary injunctions.

For the foregoing reasons, plaintiff's motion should be denied. A proposed order is attached.

August ___, 2000   Respectfully submitted,

                                                      _____
                                                      Wilma A. Lewis
                                                      D.C. Bar #358637
                                                      United States Attorney

---

[12] *See* Exhibit 1: Erik Baard, *U.S. Grants Patent on Novel Hydrogen Energy Source*, DOW JONES NEWSWIRE, (Feb. 18, 2000) (quoting the inventor Mr. Mills and his counsel Mr. Melcher). At the time of the May 22, 2000, hearing, defendant's counsel did not know that a press inquiry on February 17, 2000, by Mr. Baard prompted the review of the still pending applications. If this Court desires, Defendant can submit affidavits to demonstrate that the press inquiry prompted the review.

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Mark E. Nagle
D.C. Bar #416364
Assistant U.S. Attorney

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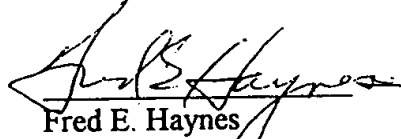
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MAILED: FEB 1 2 2001

Paper No.:

In re Application of
Randall L. Mills
Serial No.'s: 09/009,837; 09/008,947;
09/009,294; 09/110,678; 09/111,003;
09/501,622; 09/110,694; 09/110,717;
09/225,687; and 09/362,693

COMMUNICATION
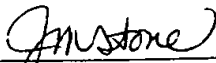
This communication is in response to your letter addressed to Ms. Esther Kepplinger, dated January 19, 2001. In your letter, you state that a personal interview on the above-identified applications has been scheduled for February 21, 2001, 10:00 a.m.

Examination procedures with respect to interview practice are set forth in MPEP 713.01. The purpose of an interview on the merits is to advance the prosecution of applications through clarification, discussion and possibly resolution of the legal and technical issues raised in an Office Action. Consequently, I have arranged for the Primary Examiners and Supervisors who were directly involved in the creation of the Office actions in the pending applications, to be present at the interview. These individuals are Wayne Langel, Vasu Jagannathan, and Steve Griffin.

Issues raised in your letter which are not germane to the advancement of prosecution on the pending applications are outside the scope of an interview, and will not be addressed during that time.

It is our hope that the interview on the merits will constitute a beneficial discussion of the legal and technical positions set forth by the examiners.

Sincerely,

Jacqueline M. Stone, Director
Director, Technology Center 1700
Chemical and Materials Engineering

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re PATENT Application of
Mills

Group Art Unit: 2721

Application No. 09/220,970

Examiner: B. Tadayon

Filed: 12/23/98

For: A METHOD AND SYSTEM FOR PATTERN RECOGNITION AND
PROCESSING

*   *   *   *   *

February 9, 2001

APPEAL BRIEF

Hon. Asst. Commissioner of Patents
 and Trademarks
Washington, D.C. 20231

Sir:

This is an appeal from the rejection of claims 51-322 of the subject application.
This Appeal Brief is submitted in triplicate as required by 37 C.F.R. § 1.192 (a).

1.   Real Party in Interest:

This application is wholly owned by the inventor, Dr. Randell L. Mills, who is the
Appellant.

2.   Related Appeals and Interferences:

There are no other appeals or interferences known to Appellant or the
Appellant's legal representative that will directly affect or be directly affected by or
otherwise have a bearing on the Board's decision in the pending appeal.

8. <u>Grouping of Claims</u>:

For purposes of the rejection of claims 51-322 under 35 U.S.C. § 101 in this Appeal only: claims 51-126 do not stand or fall with any other group of claims; claims 127-155, 157-159, 271-280 and 294-298 do not stand or fall with any other group of claims; claims 156 and 281-284 do not stand or fall with any other group of claims; claims 160-270, 290-293 and 299-306 do not stand or fall with any other group of claims; claims 285-289 do not stand or fall with any other group of claims; and claims 307-322 do not stand or fall with any other group of claims. Separate arguments have been provided for each group of claims identified above.

For purposes of the rejection of claims 51-322 under 35 U.S.C. § 112 in this Appeal only, all claims 51-322 stand or fall together.

For purposes of the rejection of claims 51-322 under 35 U.S.C. § 102 over Bates in this Appeal only, all claims 51-322 stand or fall together.

9. <u>Arguments</u>:

This appeal raises some rather unique issues in terms of the circumstances surrounding the prosecution of the present application. These circumstances - - which include two thorough examinations resulting in independent determinations of allowability of all claims, followed by a suspicious transfer of the case to a new Examiner and rejection of the claims - - were highly unusual to say the least and bear directly on the merits of the case. Due to these unusual circumstances, as summarized below, Appellant has not only been denied the patent rights to which he is entitled, but has also been denied the right to fundamental fairness in the conduct of the examination process that is to be expected of the U.S. Patent Office.

The present Application was initially examined by three Examiners, Examiner Kanji Patel, Primary Examiner Christopher S. Kelly and Primary Examiner Matt Bella. As a result of this initial examination, Examiner Bella indicated to Appellant during a first

interview that the claims would be allowed if the minor formal amendments shown in the Interview Summary were made since there were no prior art rejections of record. This initial indication of allowability was confirmed in a second examination by a Section 101 panel of three senior Examiners who found that the amended claims would indeed comply with Section 101 if the suggested amendments were made. Relying upon these representations, Appellant amended the claims in the Amendment dated January 27, 2000, which placed the Application in condition for allowance.

Subsequently, at the "eleventh hour," the present application was transferred without warning or explanation to new Examiner Bijan Tadayon. Examiner Tadayon, in complete disregard of the prior examinations indicating allowability, and who, by his own admission, lacks expertise in the field of artificial intelligence and did not take the time to adequately study the application, entered the rejection from which this Appeal is taken.

Appellant respectfully submits that the present application was improperly transferred and the claims rejected in an arbitrary and capricious manner. More specifically, the present application was transferred and rejected, not on the merits of the claimed invention, but rather, based solely on Appellant's status as the named inventor. Regrettably, as the following facts demonstrate, this prejudicial action conforms with a prior pattern of abuse and harassment targeted against Appellant.

The initial Examiners in this case, Examiner Patel and Primary Examiner Kelly, issued an Office Action on September 3, 1999 rejecting all of the claims solely under 35 U.S.C. § 101. No prior art rejections were made of record. To resolve the Section 101 rejection, the undersigned and the Appellant attended a first personal interview with Primary Examiner Bella and Examiner Patel held on November 23, 1999. During the interview, Examiner Bella demonstrated his clear understanding of the invention, including its inherent utility and the adequacy of the disclosure. Indeed, Examiner Bella showed himself quite capable of intelligently discussing in detail the structure of the algorithm and flow chart underlying an embodiment of the invention and easily relating that structure to the claims, on a claim-by-claim basis. During the interview, Examiner Bella agreed that the claims represented patentable subject matter and would be allowed if minor formal amendments were made to include the purpose of pattern recognition. Examiner Bella further stated that he would personally attend the Section

101 panel of three supervisory patent Examiners that review claims containing algorithms for compliance with 35 U.S.C. § 101, as indicated in the Interview Summary of November 23, 1999.

The Section 101 panel reviewed the claims and confirmed their allowability. Subsequently, in a telephone conversation with the undersigned, Examiner Bella reaffirmed his original determination that the claims would be in allowable condition if minor formal amendments were made to the claims, including amending the preambles of claims 1, 27, and 33 to further clarify a useful purpose, as shown in the Interview Summary. These amendments were submitted in the Amendment dated January 27, 2000 under the assumption that all claims would be allowed.

Only three weeks later, certain unfortunate events unfolded outside the procedural history of the present application that drastically changed the status of this case and resulted in this Appeal. On February 17, 2000, Director Esther Kepplinger of Art Group 1700 improperly withdrew an unrelated application of Appellant, U.S. Serial No. 09/009,294, from issuance, that was due to issue as U.S. Patent No. 6,030,601 on February 29, 2000. Appellant has good reason to believe that she took that unprecedented action, without even the slightest review of the application, in response to competitive forces outside the Patent Office aligned against Appellant. See Director Kepplinger letter dated February 28, 2000 (Exhibit 2). Director Kepplinger also improperly withdrew from issuance four other allowed patent applications of Appellant that were due to issue as patents. The subject matter of these withdrawn patent applications bears no relation whatsoever to the underlying artificial intelligence technology disclosed in the present application on appeal, but rather, relates to the field of quantum mechanics. Director Kepplinger's unfounded attack on Appellant in withdrawing his allowed patent applications from issue is presently the subject of ongoing litigation, now before the U.S. Court of Appeals for the Federal Circuit (Appeal No. 00-1530).

In view of this prior history, it can hardly be viewed as coincidence that the present application was transferred away from Examiner Bella, who indicated allowable subject matter, to Examiner Tadayon for rejection during the very same week of

February 17, 2000 that Appellant's unrelated allowed applications were withdrawn from issuance. Clearly, the timing of these events demonstrates the transfer and rejection of this case was merely a continuation of the bias that was first invoked against Appellant in Director Kepplinger's attack on Appellant's other applications in Art Group 1700 and raises suspicions that motives beyond an open and honest prosecution on the merits of this case may have been a factor. Adding to this suspicion is the fact that Examiner Tadayon, in rejecting claims to Appellant's presently appealed application, has cited references relating to "quantum mechanics" and the "Schrodinger equation," subjects corresponding to Appellant's prior withdrawn applications, even though the presently claimed artificial intelligence invention does not relate to quantum mechanics.

Further suspicions were raised by Examiner Tadayon's statements to the undersigned during a second interview held on June 1, 2000 following the transfer of the case. During that interview, Examiner Tadayon alleged that he took control over the present application based on his supposed expertise in the field of artificial intelligence. It became increasingly clear, however, from discussions held during the interview that Examiner Tadayon lacked even a basic understanding of Appellant's novel usage of Fourier series in Fourier space.

Incredibly, Examiner Tadayon flatly refused to even discuss the present claims or the Section 101 and 102 rejections during the interview, and would only discuss a limited aspect of the Section 112 rejection, as reflected in the Interview Summary. Examiner Tadayon gave the following reasons for his steadfast refusals: (1) he was not the Examiner who made the Section 101 and 102 rejections; (2) he was not an expert on Section 101 rejections; and (3) he would need to confer with other Examiners in response to any questions we had regarding the claims and the Section 101 rejection.

Appellant respectfully submits that by wresting control of the present application away from Examiner Bella (who with clear understanding of the claimed invention indicated its allowability, as did the Section 101 panel of three senior Examiners) and giving it Examiner Tadayon (who rejected the claims despite his lacking such understanding) lends credence to Appellant's belief that the Patent Office is more interested in punishing Appellant than conducting an open and honest prosecution on the merits of this case.

Since Examiner Tadayon was not the Patent Office official responsible for formulating the rejections in this case, as is quite apparent from his comments, Appellant requests that a full disclosure be made on the record of all Patent Office officials and outside consultants who provided input on the pending Office Action.

Apparently, this is not the first instance in which one of Appellant's applications has been secretly examined using a "figurehead" Examiner and information relating to that clandestine examination withheld from Appellant to his detriment. Appellant is now aware that a "secret committee" of Examiners and Directors have been convened to conduct a "behind-the-scenes" prosecution of other applications submitted by Appellant. See Director Kepplinger letter dated January 19, 2001 (Exhibit 3).

Other improprieties surrounding the examination of Appellant's applications have also been uncovered. For Example, Appellant has learned from Dr. Peter Zimmerman (chief science advisor at the U.S. Department of State and member of American Physical Society) that there is a "Deep Throat" contact in the Patent Office with whom Dr. Robert Park (spokesperson for the American Physical Society and a competitor of the Appellant) has had communications regarding Appellant's pending patent applications. The Patent Office was made aware of this outrageous situation over four months ago in connection with the above-mentioned litigation and, to this day, has not refuted it. See the Kepplinger letter dated January 19, 2001 (Exhibit 3).

Appellant has further learned through Mr. Ivan Solotaroff, a reporter for Philadelphia Magazine and for The New York Times Magazine, that Dr. Park has attacked the presently appealed application. Mr. Solotaroff conveyed to Appellant Dr. Park's statement to him that "Randy [Mills, Appellant] doesn't get it, the money is in the Quantum Computer based on entanglement and simultaneous computation in multiple parallel dimensions [greater than four]." Mr. Solotaroff also relayed how Dr. Park bragged about blocking the present artificial intelligence patent application from being allowed because it may interfere with the Quantum Computer project endorsed by the American Physical Society that is funded by the Department of Defense to the sum of over a hundred million dollars.

Appellant respectfully submits that the questionable timing of the transfer of the pending application to Examiner Tadayon, his refusal to discuss in an interview the pending claims and the Section 101 and 102 rejections of the claims, and his admission that other unnamed officials were responsible for actually preparing the Section 101 and 102 rejections are entirely consistent with the reporting of Dr. Park's boasts about blocking allowance of the pending application.

Moreover, the limited extent to which Examiner Tadayon was willing to discuss the Section 112 rejection during the interview and his strained arguments lend further credence to the notion that forces beyond those ordinarily encountered during the patent examination process were being brought to bear against Appellant. As detailed in the lengthy four-page Interview Summary, the Examiner was intent on finding non-existent holes in the logic of Appellant's invention using strained logic of his own that bordered on non-sensical.

Notably, Examiner Tadayon was extremely combative during the personal interview, particularly in his improper focus on mathematical formula described in the written description instead of on the claimed invention. Unfortunately, in doing so, he failed to grasp mathematical concepts that should have been readily apparent. For instance, contrary to the Examiner's comment on page 2 of the Interview Summary, the formula on page 11, line 29 is a proper Fourier series in Fourier space, as discussed more fully below in response to the Section 112 rejection. Furthermore, contrary to the Examiner's comment on page 3 of the Interview Summary, the filter described on page 14, lines 1, is a proper filter, as discussed below in response to the Section 112 rejection. When the topic of discussion turned to the claimed invention and Examiner Tadayon was questioned why the simple-to-follow and detailed flow charts provided in Figs. 1-21E did not comply with the requirements of Sections 101 and 112, inexplicably, he could not articulate any response.[1]

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[1] Appellant's full response to the Section 112 rejection is provided in a separate section below.

Yet another example of Examiner Tadayon's misunderstanding of the claimed subject matter was his assertion during the interview that Appellant had derived a new Fourier transform operation and his insistence that Appellant provide a mathematical proof thereof. The Examiner apparently fails to recognize that Fourier-type transforms are well known and that Appellant is simply using a novel method to parameterize data to form a novel type of Fourier series. Ironically, Appellant has already gone well beyond what the patent laws and rules require by providing detailed derivations of the mathematical formulae and examples in the Sub-Appendices to the application.

Ignoring the disclosed derivations, Examiner Tadayon requested additional proof of orthoganality for Fourier series based upon his mistaken belief that a data set input to Appellant's system must have the property of orthogonality in order that it could be parameterized into a Fourier series as taught by Appellant. This argument is simply non-sensical. Real world data is not necessarily orthogonal, nor does Appellant's invention require the data sets to be orthogonal. After even a cursory review of the application, it is clear that Appellant's disclosed invention does not teach Fourier transforming the input data as a waveform into a Fourier series with the requirement of orthogonal components. See Siebert, W. McC., _Circuits, Signals, and Systems_, The MIT Press, Cambridge, Massachusetts, (1986), pp. 364-384, cited on page 106 of the present application (Exhibit 4). In one embodiment, Applicant teaches FORMATTING the data as parameters ρ_{0_-} and $N_{m_{\rho_0}}$ of each component of a Fourier series in Fourier space. This format permits the determination of the spectral similarity of one set of data so formatted and another formatted in the same manner. In another embodiment, the data is simply formatted in terms of a specific memory structure that determines the parameterization of a formula for determination of the spectral similarity of one set of data and another. See page 13, line 1 to page 16, line 15 and page 45, lines 3-8 of the present application.

To his credit, Examiner Tadayon did offer an explanation during the interview for his lack of familiarity with the subject matter of the claimed invention, stating that he was so busy teaching new Examiners that he did not have time to learn the invention. This begs the question: Why did Examiner Tadayon take over prosecution in the first place if he was too busy to properly study the application and give it proper consideration?

Appellant has spent over two years prosecuting this application at considerable expense. It is simply outrageous that the Patent Office would subvert allowance of this case by ignoring the thorough examination conducted by three previous Examiners and the Section 101 panel of senior Examiners specializing in reviewing claims containing algorithms, and by transferring the case under suspicious circumstances to an Examiner who admittedly is not an expert in the field of artificial intelligence and was unable to articulate the basis for his rejections.

Such unfair treatment of Appellant's patent application constitutes an intolerable abuse of the examination process and undermines the merits of the pending rejections in this case.

I.   **Claims 51-322 fully comply with 35 U.S.C. § 101.**

On page 3 of the Office Action dated March 14, 2000, the Examiner rejected all claims 51-322 under 35 U.S.C. § 101 for lacking patentable utility since the invention is not connected to the "physical world."

Appellant respectfully submits that all claims 51-322 fully comply with Section 101. Original claims 1-50 were rejected under Section 101. Appellants specifically amended the claims in the Amendment dated January 27, 2000 (new claims 51-322) as suggested by the previous Examiner Bella to address and overcome the Section 101 rejection. Appellant submits that the Section 101 panel of three senior Examiners, which specializes in reviewing claims containing algorithms for compliance with Section 101, has already implicitly reviewed claims 51-322 and also found them to be in compliance with Section 101.

Claims 51-322 also comply with Section 101 for the following additional reasons.

Even though Appellant agrees with the Section 101 panel of senior Examiners that the present claims 51-322 fully comply with Section 101, to reduce the issues for appeal, Appellant has contemporaneously filed an Amendment of claims of 51 and 118 to include input and/or output steps as suggested by Examiner Tadayon. Thus, the part of Examiner Tadayon's Section 101 rejection regarding claims 51-126 is obviated.

The part of the Section 101 rejection regarding claims 127-156 and 160-322 is without merit for the following reasons and is thus appealed. 35 USC §101 limits the scope of statutory subject matter, i.e., those things that can be patented, to any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof.

Two recent Federal Circuit cases address the proper focus of the Section 101 inquiry as it pertains to algorithm-related inventions. *State Street Bank & Trust Co. v. Signature Financial Group, Inc.,* 47 USPQ 2d 1596 (Fed. Cir. 1998) and *AT&T Corp. v. Excel Comm. Inc.,* 50 USPQ 2d 1447 (Fed. Cir. 1999). As stated in *AT&T* at 1454, the proper focus is "whether the algorithm-containing invention, as a whole, produces a tangible, useful result." *State Street,* provides a slightly different standard, namely, if a claimed mathematical algorithm produces "a useful, concrete and tangible result," then the claimed algorithm is deemed to have a practical use and thus presents patentable subject matter under Section 101. at 1602, See also MPEP§2106(II)(A) (The Patent Office explicitly follows the *State Street* standard).

The Federal Circuit has also made clear that the "useful, concrete and tangible result" that is required of algorithm-containing inventions is not necessarily a physical result. For example, in, *AT&T*, the tangible, efficiency in management of investment funds satisfied the useful and concrete result requirement. 50 USPQ2d at 1452 ("In *State Street,* we held that the processing system there was patentable subject matter because the system takes data representing discrete dollar amounts through a series of

mathematical calculations to determine a final share price – a useful, concrete, and tangible result."); *See also In re Lowry,* 32 USPQ 2d 1031, 1035 (Fed. Cir. 1994) (holding that increased efficiency in computer operation is a useful, concrete and tangible result).

In accordance with this caselaw, all of the pending claims provide a tangible, useful result, namely, the recognition of a pattern in data and, thus, fully comply with Section 101. Previous Examiner Bella and the Section 101 panel explicitly recognized this standard when they required that the claims be amended to recite the purpose of recognizing the pattern in data.

Certain pending claims can also be shown to define patentable subject matter under Section 101 based on the "safe-harbor" provided in the Federal Circuit's *In re Lowry* decision. According to that case, all that is required to comply with Section 101 is that a claim set forth a "data structure" as do certain pending claims. 32 F. 3d 1579,1584 ("Data structures are physical entities that provide increased efficiency in computer operation."). Of course, as explained above, the increased efficiency of Appellant's inventive data structure further qualifies as the "useful, concrete and tangible result" that later courts have required. Thus, claims 307-322, which all require a "data structure in a memory for access by a computer program for processing information," fully comply with Section 101. Furthermore, claims 127-155, 157-159, 271-280 and 294-298 all require storing data in a memory, which is a connection to the "physical world" and thus, they too fully comply with Section 101.

The Federal Circuit's decision in *In re Beauregard* establishes another "safe harbor" providing additional support for the utility of Appellant's claimed invention. 53 F. 3d 1583, 35 USPQ 2d 1383 (Fed. Cir. 1995). In that case, the Commissioner of PTO agreed, and the Court concurred, that a computer program embodied in a tangible medium is statutory subject matter under Section 101. Thus, claims 160-270, 290-293

and 299-306, which all require "a computer-readable medium," fully comply with Section 101.

In addition, claims 156 and 281-284 recite a "system" comprising a memory and, thus, unambiguously constitute apparatus claims. The Examiner's comments regarding "connecting the invention to the physical world" therefore do not apply and these claims fully comply with Section 101.

Further, claims 285-289 fully comply with Section 101 since they recite independent physical activities performed by specific structures, and these claims specifically require the claimed objective of recognizing a pattern in data. These claims also recite providing an input layer, which directly connects them to the physical world and, thus, addresses Examiner Tadayon's concerns.

For all of the foregoing reasons, Appellant submits that all of the pending claims 51-322 fully comply with Section 101.

II.   **Claims 51-322 fully comply with 35 U.S.C. § 112, first paragraph.**

In the Office Action dated March 14, 2000, the Examiner rejected all claims 51-322 under 35 U.S.C. § 112, first paragraph. Appellant respectfully submits that all claims 51-322 fully comply with Section 112, first paragraph, for the following reasons.

The invention is clearly disclosed in the present application such that one skilled in the art could make and use the same. For example, one skilled in the art would easily be able follow the detailed flow charts in Figs. 1-5 and 18-21E and configure a computer to carryout the claimed utility of pattern recognition. Appellant notes that Examiner Tadayon ignores these flow charts in the present Office Action and has refused to respond to any questions posed during the interview regarding their relevance to the claimed invention.

Examiner Tadayon also ignores the disclosure in his broad conclusory statements on page 4 of the Office Action:

> "Applicant has used a lot of well-known methods, concepts, physical formulations, and mathematical analysis. . . . the applicant has failed to teach the connection between these concepts in the current application, and has not explained to an ordinary skill in the art as to how one can implement the disclosure, without further experimentation and/or substantial research, which puts a lot of burden on the ordinary skill in the art. The incomplete or vague specification does not satisfy the requirements for proper patent disclosure."

These statements are wholly without merit. First, the proper standard is "one skilled in the art" not "an ordinary skill in the art." Second, Appellant has gone far beyond the requirements of Section 112, first paragraph, in terms of providing adequate disclosure. Unfortunately, Examiner Tadayon has chosen to ignore that disclosure for reasons Appellant fails to comprehend. As noted above, Examiner Tadayon has ignored the easy-to-follow flow charts in making his rejection and has refused to even discuss their relevance. In addition to these flow charts, Appellant provided a detailed written description of example embodiments, as well as a Support Appendix and Sub-Appendices in the application as reference materials for background mathematics and theory.

Still further, Appellant's specification provides examples of various processes carried out by the invention. One example includes the recognition of a geometric shape, such as a triangle, disclosed starting on page 7, line 35 of the present application: "The following example illustrates how the present invention processes the physical characteristics of an item of interest, specifically a triangle."

On page 5 of the Office Action, Examiner Tadayon posits further conclusory statements demonstrating a lack understanding of the claimed invention, rather than any defect in the disclosure: "the relationships between the following concepts are not clear in the specification of the current application . . . [a long list of terms is cited]." Appellant submits that following a simple and complete reading of the application, including the flow charts of Figs. 1-5 and 18-21E, one skilled in the art would easily understand the relationships between the terms cited by the Examiner.

Given the fact that Examiner Tadayon was admittedly too busy training Examiners to learn the invention and, thus, apparently did not have sufficient time to read and study the application, Appellant provides the following detailed citations to the written description of the application for each of the terms cited by the Examiner on page 5 of the Office Action in the hope that this exercise will eliminate some of the issues on appeal:

pattern recognition- one of the functions of the invention is to recognize a pattern in input data according to a pattern with which the system is initialized. See Summary of the Invention and page 12, lines 25-34 of the application.

Fourier space- the information is represented as a Fourier series in **Fourier space** in that the data comprises the parameters of each component of the series. At page 2, lines 15-20, the application teaches, "One aspect of the present invention is directed to inputting information as data to the system within an input context and associating the data. This aspect of the invention includes encoding the data as parameters of at least two Fourier components in Fourier space, adding the Fourier components to form at least two Fourier series in Fourier space, the Fourier series representing the information"

As shown in the equation on page 8, line 26 of the application, in this example frequency is a variable in the present novel Fourier series in Fourier space. See page 8, lines 25-29 of the application for an example of a Fourier series in Fourier space defined according to the present invention, which must be distinguished from conventional Fourier series. Fourier space is also referred to as k,ω – space. See page 24, line 34 to page 25, line 22 of the application.

different layers (Input, Association, String Ordering, Predominant Configuration Layer)- layer is a term of art in computer science which refers to a specific operation of a program. At page 24, lines 10-17, the application teaches, "The methods and systems of the present invention are herein defined as the "processor" which is capable of storing, retrieving, and processing data to form novel conceptual content according to the present invention. The "processor" comprises systems and associated processes which serve specific functions which are collectively called "layers". The "layers" are organized so as to receive the

appropriate inputs and produce the appropriate outputs according to the present invention. A function of the Input, Association, String Ordering, Predominant Configuration Layers is given at page 1, line 29 to page 2, line 14, page 7, line 11-34, and Figure 1 of the application.

Gaussian filter- An example of a Gaussian filter is disclosed at page 13, line 27 to page 14, line 3, of the application, which teaches, "The filter 34 can be a time delayed Gaussian filter in the time domain. The filter may be characterized in time by:

$$\frac{\alpha}{\sqrt{2\pi}} e^{\frac{\left(t-\frac{\sqrt{N}}{\alpha}\right)^2}{\frac{2}{\alpha^2}}}$$

wherein $\frac{\sqrt{N}}{\alpha}$ is a delay parameter, α is a half-width parameter, and t is the time parameter. The Gaussian filter may comprise a plurality of cascaded stages each stage having a decaying exponential system function between stages. The filter, in frequency space, can be characterized by:

$$e^{-\frac{1}{2}\left(\frac{2\pi f}{\alpha}\right)^2} e^{-j\sqrt{N}\left(\frac{2\pi f}{\alpha}\right)}$$

wherein $\frac{\sqrt{N}}{\alpha}$ and α are a corresponding delay parameter and a half-width parameter in time, respectively, and f is the frequency parameter." The derivation is given in SUB-APPENDIX II found on page 60, line 1, to page 64, line 36 of the application. A delayed Gaussian filter in time and its Fourier transform are known as shown by Siebert, W. McC., Circuits, Signals, and Systems, The MIT Press, Cambridge, Massachusetts, (1986), pp. 488-502. A copy is provided in Exhibit 4.

probability expectation value- Hogg and Tanis (R. V. Hogg, E. A. Tanis, Probability and Statistical Inference, MacMillan Publishing Co., Inc., New York, (1977), pp. 51-55) give a definition of the expectation value:

Definition 2.2-1. If $f(x)$ is the p.d.f. of the random variable X of the discrete type with space R and if the summation

$$\sum_R u(x) f(x) = \sum_{x \in R} u(x) f(x)$$

exists, then the sum is called the mathematical expectation or the expected value of the function $u(X)$ and it is denoted by $E[u(x)]$. That is,

$$E[u(x)] = \sum_R u(x) f(x)$$

We can think of the expected value or the expectation value $E[u(x)]$ as a weighted mean of $u(X)$, $x \in R$, where the weights are the probabilities $f(x) = P(X = x), x \in R$.

In the present invention, the probability expectation value may be any desired value as selected by the user, but is usually a number between zero and one, which represents the statistical outcome or weighted mean as the number of trials of the probability operand that returns a zero or one goes to infinity.

In an embodiment of the present invention, the probability expectation value is disclosed on page 2 lines 15-32, "One aspect of the present invention is directed to inputting information as data to the system within an input context and associating the data. This aspect of the invention includes encoding the data as parameters of at least two Fourier components in Fourier space, adding the Fourier components to form at least two Fourier series in Fourier space, the Fourier series representing the information, sampling at least one of the Fourier series in Fourier space with a filter to form a sampled Fourier series, and modulating the sampled Fourier series in Fourier space with the filter to form a modulated Fourier series. This aspect of the invention also includes determining a spectral similarity between the modulated Fourier series and another Fourier series, determining a probability expectation value based on the spectral similarity, and generating a probability operand having a value selected from a set of zero and one, based on the probability expectation value. These steps are repeated until the probability operand has a value of one. Once the probability operand has a value of one, the modulated Fourier series and the other Fourier series are added to form a string of Fourier series in Fourier space, and the string of Fourier series is stored in the memory."

similarity between at least 2 filtered and unfiltered Fourier series- While the present Fourier series are novel, conventional Fourier series are well known in the art of signal processing. Filtering a wave form is also well known, as shown by the convolutions of the time functions or the product of their corresponding Fourier transforms provided in Siebert, W. McC., Circuits, Signals, and Systems, The MIT Press, Cambridge, Massachusetts, (1986), pp. 471-502, cited on page 106, lines 3-4 of the present application (Exhibit 4). In an embodiment of the invention, a filtered Fourier series according to the present invention is given by the

multiplication of a Fourier series in Fourier space by the Fourier transform of a time delayed Gaussian filter as described on page 15, line 19 to page 16, line 12 and page 18, line 22 to page 19, line 12 of the application. As disclosed on page 2, lines 15-32, "One aspect of the present invention is directed to inputting information as data to the system within an input context and associating the data. This aspect of the invention includes encoding the data as parameters of at least two Fourier components in Fourier space, adding the Fourier components to form at least two Fourier series in Fourier space, the Fourier series representing the information, sampling at least one of the Fourier series in Fourier space with a filter to form a sampled Fourier series, and modulating the sampled Fourier series in Fourier space with the filter to form a modulated Fourier series. This aspect of the invention also includes determining a spectral similarity between the modulated Fourier series and another Fourier series, determining a probability expectation value based on the spectral similarity, and generating a probability operand having a value selected from a set of zero and one, based on the probability expectation value. These steps are repeated until the probability operand has a value of one. Once the probability operand has a value of one, the modulated Fourier series and the other Fourier series are added to form a string of Fourier series in Fourier space, and the string of Fourier series is stored in the memory."

delay parameters- refer to each time delay parameter of a delayed Gaussian filter of the present invention. (See Gaussian filter above.)

modulation factors- in the Fourier or frequency domain, a time delayed Gaussian filter samples and modulates a function which is filtered in the time domain. At page 13, line 27 to page 14, line 3, the application teaches, "The filter 34 can be a time delayed Gaussian filter in the time domain. The filter may be characterized in time by:

$$\frac{\alpha}{\sqrt{2\pi}} e^{-\frac{\left(t-\frac{\sqrt{N}}{\alpha}\right)^2}{\frac{2}{\alpha^2}}}$$

wherein $\frac{\sqrt{N}}{\alpha}$ is a delay parameter, α is a half-width parameter, and t is the time parameter. The Gaussian filter may comprise a plurality of cascaded stages each stage having a decaying exponential system function between stages. The filter, in frequency space, can be characterized by:

$$e^{-\frac{1}{2}\left(\frac{2\pi f}{\alpha}\right)^2} e^{-j\sqrt{N}\left(\frac{2\pi f}{\alpha}\right)}$$

wherein $\frac{\sqrt{N}}{\alpha}$ and α are a corresponding delay parameter and a half-width parameter in time,

respectively, and f is the frequency parameter." The term, $e^{-j\sqrt{N}\left(\frac{2\pi f}{\alpha}\right)}$ modulates the Fourier

series in Fourier space, thus, it is the modulation factor. And the term $e^{-\frac{1}{2}\left(\frac{2\pi f}{\alpha}\right)^2}$ samples the

Fourier series in Fourier space. At page 2, lines 20-23, the application teaches, " sampling at least one of the Fourier series in Fourier space with a filter to form a sampled Fourier series, and modulating the sampled Fourier series in Fourier space with the filter to form a modulated Fourier series." At page 13, lines 7-9, the application teaches "At least one of the Fourier series stored in the Fourier series section 32 is input to a filter 34 wherein the filter 34 samples and modulates the Fourier series." And, at page 13, line 27 to page 14, line 3, the application teaches, "The filter 34 can be a time delayed Gaussian filter in the time domain. The filter may be characterized in time by:

$$\frac{\alpha}{\sqrt{2\pi}}e^{-\frac{\left(t-\frac{\sqrt{N}}{\alpha}\right)^2}{2}\frac{}{\alpha^2}}$$

wherein $\frac{\sqrt{N}}{\alpha}$ is a delay parameter, α is a half-width parameter, and t is the time parameter. The Gaussian filter may comprise a plurality of cascaded stages each stage having a decaying exponential system function between stages. The filter, in frequency space, can be characterized by:

$$e^{-\frac{1}{2}\left(\frac{2\pi f}{\alpha}\right)^2}e^{-j\sqrt{N}\left(\frac{2\pi f}{\alpha}\right)}$$

wherein $\frac{\sqrt{N}}{\alpha}$ and α are a corresponding delay parameter and a half-width parameter in time,

respectively, and f is the frequency parameter." Also see SUB-APPENDIX II.

At page 32, lines 13-15, the application teaches, "Each Fourier series such as a "SFCs" representing information is filtered and delayed in the time domain (modulated and sampled in the frequency domain or k,ω – space) as it is recalled from memory".

Modulation factors also provide a basis for encoding context in the present invention. At page 7, lines 14-16 the application teaches, "The Input Layer 12 also encodes the input context as delays in time corresponding to a modulation factor of the Fourier series at corresponding frequencies." At page 10, line 34 to page 11, line 3, the application teaches,

"The time intervals represent time delays which correspond to the characteristic modulation frequency band in Fourier space which in turn represents the input context according to the specific transducer or transducer subcomponent." See also page 10, line 34 to page 12, line 2 of the application.

association ensemble- is a given as background information of a analog embodiment. At page 28, lines 9-28, the application discloses, "The Association Layer and the "String" Ordering Layer comprise cascaded processor stages which are herein defined as "stages". The "stages" need not be identical. Let $h_i(t)$ be the impulse response of the i^{th} stage and assume that $h_i(t) \geq 0$, so that the step response of each stage (or indeed of any number of cascaded stages) is monotonic. Cascaded stages form filters. The Central Limit Theorem of probability theory states in effect that, under very general conditions, the cascade of a large number of linear-time-invariant (LTI) systems will tend to have a delayed Gaussian impulse response, almost independent of the characteristics of the systems cascaded. Sufficient conditions of the Central Limit Theorem are given by Eqs. (37.52-37.55) of SUB-APPENDIX II--Modulation and Sampling Gives the Input to the Association Mechanism and Basis of Reasoning. The collective of multiple cascaded "stages" comprises an "association ensemble" that receives input such as a " SFCs". Each "association ensemble" serves as a heterodyne having an exemplary representation given by Eq. (37.50) by modulating the Fourier series in $k,\omega-$ space. It further samples the Fourier series in $k,\omega-$ space. The modulation and sampling functions correspond to a delayed Gaussian filter in the time domain having an exemplary representation given by Eq. (37.51)."

nested sets of sequential subsets of random DNA fragments- DNA is a linear sequence of ordered nucleotides. The application teaches a generalized technique that provides the determination of the linear order from random DNA fragments and presents this method in SUB APPENDIX IV and V as an exemplary method to establish an order of information represented by Fourier series in Fourier series or an equivalent representation in the form of a structured memory. At page 48, line 13 to page 49, line 2, the application teaches, "Consider the time interval $t=t_i$ to $t=t_f$ of a "string" associated by "association ensembles" and recorded to memory. By processing the "string' with multiple "association ensembles" comprising Gaussian filters each of different delay, $\dfrac{\sqrt{N_s}}{\alpha_s}$, and half-width parameter, α_s, the "string" can be "broken" into "groups of SFCs" each having a center of mass at a time point

corresponding to the delay $\frac{\sqrt{N_s}}{\alpha_s}$ and frequency composition corresponding to α_s which form

a nested set of "sequential subsets" of "groups of SFCs" of the "string" in k,ω - space which map to time points which are randomly positioned along the time interval from the $t = t_i$ -side and the $t = t_2$ -side as shown in FIGURES 8, 10, 12, and 14. This nested set of "sequential subsets" of random "groups of SFCs" mapping to random time points from the $t = t_i$ -side and the $t = t_f$ -side is analogous to the nested set of "sequential subsets" of random DNA fragments from the 5' end and the 3' end. The order in both cases can be solved by the Genomic DNA Sequencing Method/Matrix Method of Analysis [3, 4] described in SUB-APPENDIX V."

At page 34, lines 3-23, the application discloses, "The collective sampling of the specific "association ensembles" provides a nested set of subsets of information where each subset maps to a specific time point corresponding to the specific delay, $\frac{\sqrt{N_s}}{\alpha_s}$, of the specific Gaussian filter of the "association ensemble" (Eqs. (37.50-37.51)). The nested set of subsets of information is ordered by the Matrix Method of Analysis Algorithm of Appellant with Poissonian probability based associations with input from High Level Memory. Each "group of SFCs" of the input "string" has the corresponding time delay parameter, $\frac{\sqrt{N_s}}{\alpha_s}$, and the half-width parameter, α_s, of the Gaussian filter of the "association ensemble" (Eqs. (37.50-37.51)) that resulted in the "coupling" and "association" to form the "string". The process of ordering assigns a particular time delay, $\frac{\sqrt{N_{s'}}}{\alpha_{s'}}$, and half-width parameter, $\alpha_{s'}$, to each "group of SFCs" of the output "string". The half-width parameter, $\alpha_{s'}$ corresponds to each specific delayed Gaussian filter that samples the input "string" in the frequency domain to provide each "group of SFCs" of the output "ordered string". Each corresponding particular time delay, $\frac{\sqrt{N_{s'}}}{\alpha_{s'}}$, encodes and corresponds to the time domain order of each "group of SFCs" of the output "ordered string". An order processed "string" called a "P string" may comprise complex information having conceptual content."

At page 47, lines 9-19, the application discloses, "In a preferred embodiment, the string is sampled with specific "association ensembles" which provide a "nested set of

subsets" of information comprised of a "SFCs" and "groups of SFCs" where each "subset" sampled from the input "string" maps to a specific time point corresponding to the specific delay, $\frac{\sqrt{N_s}}{\alpha_s}$, of the specific Gaussian filter of the "association ensemble" (Eqs. (37.50-37.51)). The process of ordering assigns a particular time delay, $\frac{\sqrt{N_{s'}}}{\alpha_{s'}}$, and half-width parameter, $\alpha_{s'}$, to each "subset" of the output "string" using the "nested set of subsets" as input to the Matrix Method which is herein presented as a mechanism used by the "processor" to sequence information temporally, conceptually, or according to causality."

groups of SFCs- A definition and use of SFCs is in the Support Appendix and Sub Appendices to provide background for the examiner. FCs is Fourier components, SFCs is a series of Fourier components, groups of SFCs is a sum of a series of Fourier components and a string is yet a further sum of Fourier series. FIGURE 19 is a flow diagram of an exemplary hierarchical relationship of the signals in Fourier space comprising "FCs", "SFCs", "groups of SFCs", and a "string" accordance with the present invention. An exemplary layer structure is shown in FIGURE 20.

At page 40, line 29 to page 41, line 12, the application discloses, "A "FC" of Eq. (37.32) is a series of a Fourier component. A distinct superposition or series of "FCs" is called a "SFCs" which further superimpose to form "groups of SFCs". The data is digitized according to the parameter N of Eqs. (37.33), (37.33a), and (37.87)."

memory ensemble- background is given in the Support Appendix and Sub Appendices that provides an analog embodiment. At page 35, lines 26-27, applicant teaches, "and a strongly linked group of memory elements comprises a "memory ensemble".

P element- is a processing element as described according to its impulse response as given in SUB APPENDIX I that describes an analog embodiment. At page 26, line 12 to page 27, line 16, the application teaches, "All layers comprise processor elements called "P elements" each with a system function response defined as the "impulse response" (Eqs. (37.22-37.24)) and an output (herein defined as the "P element response") shown in FIGURE 6 comprising a "pulse train of impulse responses"--an integer number of traveling dipole waveforms (each called an "impulse response"). The Fourier transform of this signal is the

convolution of a sinc function with a periodic series of delta functions where the amplitude and the width of the sinc function is determined by the integer number of "impulse responses" of the signal. In a preferred embodiment, the amplitude of the "impulse response", the temporal and spatial spacing or repetition frequency of the "impulse responses", and the integer number of "impulse responses" of the "P element" signal is proportional to rate of voltage change called "depolarization" of the "P element". This rate is determined by the amplitude and rate of change of the input. Thus, in the preferred embodiment, each "P element" is a linear differentiator--the output (pulse train of "impulse responses") is the sum (superposition) of the derivative of the inputs. Additionally in the embodiment, the "P element" has a threshold of "depolarization" to generate an output. In this case, the Fourier transform of "P element response" comprises a repeated series of a Fourier component herein defined as a "FC" with quantized frequency and phase angle. In another embodiment, the amplitude is also quantized. In k,ω - space, the Fourier transform of the "impulse response" function filters the "FC" of a "P element" and is a band-pass when the spatial frequency of the "FC" is equal to the temporal frequency (i.e. the "FC" is band-passed when $k_\rho = k_z$).

An exemplary output signal of an analog "P element" to an input of the form given by Eq. (37.26) is given in time by Eq. (37.27) (the parameters ρ_0, z_0, and N may encode quantitative information such as intensity and rate of change of a physical parameter such as temperature) and in k,ω - space by Eq. (37.32). The latter equation is that of a series of a Fourier component with information encoded in the parameters ρ_0 and N of the Fourier component. "P elements" are directionally massively interconnected in terms of the inputs and the outputs of the present invention which may superimpose. Multiple "P elements" input into any given "P element" which then outputs to multiple "P elements. The Fourier transform of the superposition of the output of multiple "P elements" is a repeating Fourier series--a repeating series of trigonometric functions comprising a series of Fourier components "FCs" herein referred to as a " SFCs". Exemplary representations are given by Eq. (37.33) and Eq. (37.33a). Thus, the present "processor" may function as an analog Fourier processor."

association mechanism- SUB-APPENDIX II is the derivation of the Modulation and Sampling Gives the Input to the Association Mechanism and Basis of Reasoning according to the

present invention, and SUB-APPENDIX III is the derivation of the Association Mechanism and Basis of Reasoning according to the present invention. The theory is presented to provide understanding for the system disclosed at pages 1-24. At page 72, lines 6-22, the application teaches, "In one embodiment, the present "processor" is an analog Fourier processor wherein the data is digitized according to the parameter N of Eqs. (37.33), (37.33a), and (37.87). Each "FC" of Eqs. (37.33) is a series of a Fourier component with quantized frequency and phase angle. Each "FC" of Eqs. (37.33a) is a series of a Fourier component with quantized amplitude, frequency, and phase angle. Each "SFCs" represented by Eq. (37.33) and Eq. (37.33a) is filtered and delayed in the time domain (modulated and sampled in the frequency domain) as it is recalled from memory and processed by an "association ensemble". "Association ensembles" produce interference or "coupling" of the "SFCs" of one set of "M or P elements" with that of another by producing frequency matched and phase locked Fourier series --sums of trigonometric waves that are frequency matched and periodically in phase--that give rise to "association" of the corresponding recalled or processed information. The Poissonian probability of such "coupling" (Eq. (37.106)) can be derived from the correlation function (Eq. (37.78) wherein Eq. (37.87) is a parameter."

At page 79, line 21 to page 80, line 3, the application teaches, "Eq. (37.106) gives the probability $P_A\left(\dfrac{\sqrt{N_1}}{\alpha_1},\dfrac{\sqrt{N_2}}{\alpha_2},...,\dfrac{\sqrt{N_s}}{\alpha_s},\delta_s\right)$ of the occurrence of "association" of the corresponding Fourier series based on a first "active" "association ensemble" with modulation $e^{-j\sqrt{N_1}\left(\frac{2\pi f}{\alpha_1}\right)}$ given by Eq. (37.50) "coupling" with s separate "association ensembles" each with modulation $e^{-j\sqrt{N_s}\left(\frac{2\pi f}{\alpha_s}\right)}$ given by Eq. (37.50) and independent phase shift, δ_s. The process of first establishing "associations" between different Fourier series representative of different pieces of information is the basis of producing information with novel conceptual content. The formation of "associations" is also the basis of reasoning. The generation of "associations" depends on the statistics of "coupling" of multiple "association ensembles" each comprised of cascaded association "stages". Then the "associated" information is ordered or further processed to provide general context such as cause and effect relationships by a mechanism involving the half-width parameters, α_s, the time delay parameters, $\dfrac{\sqrt{N_s}}{\alpha_s}$, and potentially the independent phase shifts, δ_s, of Eq. (37.106). The

ordering of "associated" information is described in SUB-APPENDIX IV--Ordering of Associations: Matrix Method.

At page 13, lines 10-26, the application teaches the use of probability to make an association and form a string of Fourier series representing the associated information, "A spectral similarity value is output from the spectral similarity analyzer 36 and input to a probability expectation analyzer 38. The probability expectation analyzer 38 determines a probability expectation value based on the spectral similarity value. The probability expectation value output from the probability expectation analyzer 38 is input to a probability operand generator 40. The probability operand generator 40 generates a probability operand value of one or zero based upon the probability expectation value. The probability operand value is output to a processor 42. If the probability operand value is zero, the processor 42 sends another Fourier series from the Fourier series section 32 of the temporary memory section 28 to the filter 34 and begins the process again. If the probability operand value is one, the filtered Fourier series and the other Fourier series are added to form a string and the string is stored in a string memory section 44."

basis of reasoning- The theory is presented to provide understanding for the digital system disclosed at pages 1-24. SUB-APPENDIX III is the derivation of the Association Mechanism and Basis of Reasoning according to the present invention which gives the theoretical basis and background of the operability of an analog system of the present invention to achieve pattern recognition and create information of novel content. (See association mechanism above.)

the coupling- refers to an analog system disclosed in SUB-APPENDIX III. The term "the coupling" is used by Appellant as a means of illustrating the theory of determination of spectral similarity by an analog system wherein energy may be transferred from one excited system to another if the corresponding spectra of the transferring and receiving then excited system are sufficiently similar. The coupling establishes an association and is described in the association mechanism given above.

energy difference between the final and initial nuclear states- is considered in the derivation of exemplary background theory of the physical behavior of a large number of "active"

cascaded association "stages" (an "association ensemble") each weakly linked to provide a Poissonian probability of "coupling" to one or more "stages" of one or more different "association ensembles". The derivation is given in SUB-APPENDIX III as a means of illustrating the theory of determination of spectral similarity by an analog system wherein energy may be transferred from one excited system to another if the corresponding spectra of the transferring and receiving then excited system are sufficiently similar. The transfer establishes an association. At page 65, line 31 to page 67, line 21, the application teaches, "The physical behavior of a large number of "active" cascaded association "stages" (an "association ensemble") each weakly linked to provide a Poissonian probability of "coupling" to one or more "stages" of one or more different "association ensembles" is equivalent to that of the interaction of ultrasound with Mossbauer gamma rays. Each "association ensemble" "carries" a Fourier series in k, ω - space such as a "M or P element response" which comprises a sum of harmonic functions. Thus, physically, the former case corresponds to interference of a first Fourier series input filtered by an "association ensemble" with a second, third, or s th Fourier series input filtered by s the "association ensemble". The latter case corresponds to interference of an electronic transition and an oscillator transition. In both cases, a harmonic energized state interferes with another.

Consider the Lamb-Mossbauer formula for the absorption of a γ ray of energy E by a nucleus in a crystal given by Maradudin [11].

$$\sigma_a(E) = \frac{1}{4}\sigma_0\Gamma^2 \sum_{mn} e^{-\frac{\beta E_m}{Z}} X \frac{\rangle m|e^{i\left(\frac{p}{\hbar}\right)R(l)}|n\langle\rangle n|e^{-i\left(\frac{p}{\hbar}\right)R(l)}|m\langle}{(E_0 - E + E_n - E_m)^2 + \frac{1}{4}\Gamma^2}$$

(37.56)

In this equation, E_0 is the energy difference between the final and initial nuclear states of the absorbing nucleus, E_m and E_n are the energies of the eigenstates $|m\langle$ and $|n\langle$ of the crystal, respectively, Γ is the natural width of the excited state of the nucleus, p is the momentum of the γ ray, $R(l)$ is the instantaneous position vector of the absorbing nucleus, Z is the crystal's partition function, $T = (k\beta)^{-1}$, and σ_0 is the resonance absorption cross section for the absorbing nucleus. By expressing the denominator of Eq. (37.56) as an integral, Eq. (37.56) is equivalent to

$$\sigma_a(E) = \frac{1}{2}\sigma_0\gamma \int_{-\infty}^{\infty} dt e^{i\omega t - \gamma|t|} X\rangle exp[-i\mathbf{k} \cdot \mathbf{u}(l;t)]exp[i\mathbf{k} \cdot \mathbf{u}(l;0)]\langle$$

(37.57)

wherein the position vector $R(l)$ is

$$R(l) = x(l) + u(l)$$

(37.58)

For, Eq. (37.58), $x(l)$ is the position vector of the mean position of the absorbing nucleus, and $u(l)$ is its displacement from the mean position. Eq. (37.57) follows from Eq. (37.56) with the following substitutions:

$$\left(\frac{1}{\hbar}\right)\mathbf{p} = \mathbf{k} \tag{37.59}$$

$$\hbar\omega = E - E_0 \tag{37.60}$$

$$\gamma = \frac{\Gamma}{2\hbar} \tag{37.61}$$

and $u(l;t)$ denotes the Heisenberg operator,

$$u(l;t) = e^{i\left(\frac{t}{\hbar}\right)H} u(l;0) e^{-i\left(\frac{t}{\hbar}\right)H} \tag{37.62}$$

where H is the Hamiltonian. The angular brackets in Eq. (37.57) denote an average over the canonical ensemble of the crystal.

The correlation function for the statistical average of a large number of "active" cascaded association "stages" (an "association ensemble") each weakly coupled to one or more "stages" of one or more different "active" "association ensembles" is equivalent to that of the interaction of ultrasound with Mossbauer gamma rays. From Eq. (37.57), the correlation function $Q(t)$ of acoustically modulated gamma ray absorption by Mossbauer nuclei is

$$Q(t) = \rangle exp[-i\mathbf{k} \cdot u(l;t)] exp[i\mathbf{k} \cdot u(l;0)]\langle \tag{37.63}$$

In the present case, $u(l)$ corresponds to the delay of an "association ensemble" s comprising a time delayed Gaussian filter. In k,ω – space, the time delay corresponds to a modulation of the s th Fourier series (e.g. "P or M element response" given by Eq. (37.33)) that is "carried" by the "association ensemble" s). Since the Fourier series is a sum of trigonometric functions in k,ω – space, the modulation corresponds to a frequency shift of the Fourier series "carried" by the "association ensemble" s. $\mathbf{k}$ of Eq. (37.59) corresponds to the wavenumber of the frequency shifted s th Fourier series. $\frac{E - E_0}{\hbar}$ of Eq. (37.60) is the shifted frequency of a first Fourier series that is "carried" by a first "association ensemble"."

interaction of ultrasound with Mossbauer gamma rays- is part of the derivation described above for the energy difference between the final and initial nuclear states regarding exemplary background theory of the physical behavior of a large number of "active" cascaded association "stages" (an "association ensemble") each weakly linked to provide a

Poissonian probability of "coupling" to one or more "stages" of one or more different "association ensembles". The derivation is given in SUB-APPENDIX III as a means of illustrating the theory of determination of spectral similarity by an analog system wherein energy may be transferred from one excited system to another if the corresponding spectra of the transferring and receiving then excited system are sufficiently similar. The transfer establishes an association. At page 67, lines 22-24, the application reaches "In the case of acoustically modulated gamma ray absorption by Mossbauer nuclei, $u(l;t)$ of Eq. (37.62) is

$$u(l;t) = e^{\left(\frac{t}{h}\right)E} u(l;0) e^{-i\left(\frac{t}{h}\right)E} \tag{37.64}$$

The derivation continues to page 78, lines 20-26: "Eq.(37.106b) gives one as the maximum probability of the occurrence of "association". In other embodiments, the probability maximum may be less than one. In this case, Eq. (37.106b) is

$$P_A\left(\frac{\sqrt{N_1}}{\alpha_1}, \frac{\sqrt{N_2}}{\alpha_2}, ..., \frac{\sqrt{N_s}}{\alpha_s}, P, p_{\uparrow_s}, \delta_s\right)$$

$$= \prod_s \left[p_{\uparrow_s} + (P - p_{\uparrow_s}) exp\left[-\beta_s^{-2}\left(\frac{1 - cos\, 2\phi_s}{2}\right)\right] cos(\delta_s + 2 sin\, \phi_s) \right] \tag{37.106c}$$

where P is the maximum probability of the occurrence of "association". Eq. (37.105) and Eq. (37.106) represent the "association" probability parameter."

central limit theorem- At page 28, lines 14-19, the application teaches, "The Central Limit Theorem of probability theory states in effect that, under very general conditions, the cascade of a large number of linear-time-invariant (LTI) systems will tend to have a delayed Gaussian impulse response, almost independent of the characteristics of the systems cascaded. Sufficient conditions of the Central Limit Theorem are given by Eqs. (37.52-37.55) of SUB-APPENDIX II". In SUB-APPENDIX II, the application discloses the theory and background of the delayed Gaussian filter which is used in the present invention as described under Gaussian filter and modulation factors given above. An application of the Central Limit theorem in signal processing is given in Siebert, W. McC., Circuits, Signals, and Systems, The MIT Press, Cambridge, Massachusetts, (1986), pp. 488-502, copy provided in Exhibit 4.

active association ensemble- Is a derivation regarding the theory of the physical behavior of a large number of "active" cascaded association "stages" (an "association ensemble") each weakly linked to provide a Poissonian probability of "coupling" to one or more "stages" of one

or more different "association ensembles". The derivation is given in SUB-APPENDIX III as a means of illustrating the theory of determination of spectral similarity by an analog system wherein energy may be transferred from one excited system to another if the corresponding spectra of the transferring and receiving then excited system are sufficiently similar. The transfer establishes an association. See <u>association mechanism, basis of reasoning, energy difference between the final and initial nuclear states,</u> and <u>interaction of ultrasound with Mossbauer gamma rays</u> given above.

<u>Matrix Method of Analysis of Mills-</u> A DNA sequence is a linear representation of information or pattern. A Matrix Method of analysis was provided by Appellant in SUB APPENDIX IV and V to provide further understanding of how a linear sequence of information may be sampled and analyzed to determine the correct linear order of the information. The linear order of nucleotides are generalized to represent information that is formatted in a certain order. An exemplary order generalization from position along the strand to relative position in time was presented as background. See <u>nested sets of sequential subsets of random DNA fragments</u> above.

<u>series representing the nucleotides-</u> Does not appear in the present application. Appellant postulates that Examiner Tadayan may be referring to exemplary background provided by Appellant. In an embodiment, Fourier series representing information is ordered according to some criterion. The establishment of an order of the information is achieved by generalizing the method of determining the order of nucleotides in a DNA strand to determining the order of Fourier components of the Fourier series. In this case, smaller Fourier series samples of the larger original Fourier series or string may be obtained with a filter and may be treated analogously to nucleotides in the implementation of the method of ordering. See <u>nested sets of sequential subsets of random DNA fragments</u> above. Also see page 16, line 16 to page 21, line 5.

<u>transducer string-</u> At page 12, lines 3-24, the application teaches, "Transducer strings may be created by obtaining a Fourier series from at least two selected transducers and adding the Fourier series. Transducers that are active simultaneously may be selected. The transducer string may be stored in a distinct memory location of the memory. The characteristic modulation, having a frequency within the band in Fourier space can be

represented by $e^{-j2\pi f t_0}$ which corresponds to the time delay $\delta(t-t_0)$ wherein f is the frequency variable, t is the time variable, and t_0 is the time delay.

Recalling any part of the transducer string from the distinct memory location may thereby cause additional Fourier series of the transducer string to be recalled. In other words the Fourier series are linked. Fourier series, in addition to those of transducer strings may be linked. In order to achieve linking of the Fourier series, the system generates a probability expectation value that recalling any part of one of the Fourier series from the memory causes at least another Fourier series to be recalled from the memory. The system stores the probability expectation value to memory. The system generates a probability operand, usually having a value selected from a set of zero and one, based on the probability expectation value. The system recalls at least another Fourier series from the memory if the operand is one. The probability expectation value may increase with a rate of recalling any part of any of the Fourier series."

weighting factors- Used as a method to activate the system based on past activation rates. At page 2, lines 9-14, the application teaches, "The system also includes a Predominant Configuration Layer that receives multiple ordered strings from the memory, forms complex ordered strings comprising associations between the ordered strings, and stores the complex ordered strings to the memory. The components of the system are active based on probability using weighting factors based on activation rates." In one embodiment, the activation process is akin to an operating system kernel in a forever loop. See page 21, line 9 to page 22, line 33 of application.

Poissonian probability- Associations are formed between Fourier series by filtering the Fourier series and by using a spectral similarity between the filtered Fourier series to determine the association based on probability. At page 14, lines 4-7, the application teaches, "The probability distribution may be Poissonian. Thus, the probability expectation value can be based upon Poissonian probability. The probability expectation value may be characterized by

$$\prod_s \left[p_{\uparrow_s} + (P - p_{\uparrow_s}) \exp\left[-\beta_s^{-2} \left(\frac{1 - \cos 2\phi_s}{2} \right) \right] \cos(\delta_s + 2\sin\phi_s) \right]"$$

At page 13, lines 10-26, the application teaches the use of probability to make an association and form a string of Fourier series representing the associated information, "A spectral similarity value is output from the spectral similarity analyzer 36 and input to a probability expectation analyzer 38. The probability expectation analyzer 38 determines a probability expectation value based on the spectral similarity value. The probability expectation value output from the probability expectation analyzer 38 is input to a probability operand generator 40. The probability operand generator 40 generates a probability operand value of one or zero based upon the probability expectation value. The probability operand value is output to a processor 42. If the probability operand value is zero, the processor 42 sends another Fourier series from the Fourier series section 32 of the temporary memory section 28 to the filter 34 and begins the process again. If the probability operand value is one, the filtered Fourier series and the other Fourier series are added to form a string and the string is stored in a string memory section 44."

Based upon the foregoing recitations, Appellant earnestly believes that contrary to the strained views of Examiner Tadayon, the terms identified on page 5 of the Office Action are more than adequately defined in the present specification to enable one skilled in the art to practice the claimed invention without undue experimentation.

Examiner Tadayon is further mistaken as to another allegation he makes on page 5 of the Office Action, at paragraph (II), that "[i]t is not clear how exactly the Fourier series is obtained from the DNA sequences." Contrary to the Examiner's premise, the disclosed invention does not obtain a Fourier series from a DNA sequence. A DNA sequence is a linear representation of information or a pattern. A Matrix Method of analysis is provided in SUB APPENDIX IV and V to provide further understanding of how a linear sequence of information may be sampled and analyzed to determine the correct linear order of the information according to generalize criteria. The nucleotides are generalized to represent information that is formatted in a certain order. An exemplary order generalization from position along the strand to relative position in time is disclosed. See nested sets of sequential subsets of random DNA fragments above.

Other allegations put forth by Examiner Tadayon similarly have no basis in fact. For example, on page 5 of the Office action, at paragraph (III), Examiner Tadayon alleges that

"[i]t is not clear how adding at least two of the Fourier components to form at least one Fourier series result in the recognition of the pattern." Appellant submits that the adding of at least two of the Fourier components to form at least one Fourier series is input to the determination of the spectral similarity between this Fourier series and at least another such Fourier series that represents a test pattern to be recognized in the input Fourier series if it exists. Such a determination according to the methods taught by Appellant results in the recognition. Specifically, based on the spectral similarity between the two Fourier series, the recognition of a pattern in an input Fourier series occurs when the probability operand returns a desired value, such as a one versus a zero. See page 2 lines 15-32; page 12 lines 25-34; page 13 lines 1-26 of the application.

In yet another unfounded allegation, on page 5 of the Office Action, at paragraph (IV), Examiner Tadayon alleges that "[i]n Fourier analysis, the phase and high frequency components are not treated properly. This makes the analysis incomplete. Thus, the specification lacks proper teaching." The problem here lies in the Examiner's failure to appreciate that the claimed invention does not involve Fourier transforming the input as a function of time into a conventional Fourier transform. Therefore, the Examiner's allegations regarding the improper treatment of the phase and high frequency components of a Fourier analysis are irrelevant. See page 7, line 35 to page 12, line 10 of the present application.

Examiner Tadayon's confusion on this matter is further reflected by his statement at the interview that the data set input to the system of the present invention must have the property of orthogonality in order that it could be Fourier transformed into a Fourier series. As explained above, data sets are not required to be orthogonal. In fact, such a requirement would be nonsensical since real-world data is not orthogonal. Examiner Tadayon is obviously confused, since the present invention as claimed does not teach Fourier transforming the input data as a waveform into a Fourier series with the requirement of orthogonal components. See Siebert, W. McC., Circuits, Signals, and Systems, The MIT Press, Cambridge, Massachusetts, (1986), pp. 364-384 (Exhibit 4). In one embodiment, Appellant teaches FORMATTING the data as parameters ρ_{0_-} and $N_{m_{p_0}}$ of each component of a Fourier series in Fourier space. This format permits the determination of the spectral similarity of one set of data so formatted and another formatted in the same manner. In another embodiment, the data is simply formatted in terms of a special memory structure that

determines the parameterization of a formula for determination of the spectral similarity of one set of data and another. See page 13, line 1 to page 16, line 15 and page 45, lines 3-8 of the application.

Examiner Tadayon is further mistaken regarding the disclosure relating to sampling and modulating the Fourier series in Fourier space with the Fourier transform of the delayed Gaussian filter, which corresponds to filtering in the time domain. In the Interview Summary, Examiner Tadayon states: "Thus, the filter defined on page 14 line 1 is not actually filtering process in the conventional meaning of Fourier analysis. It is only the multiplication of a "function" times a "parameterized summation of trigonometric functions" as shown in line 17 of page 14." This statement is both irrelevant and incorrect. An aspect of Appellant's invention of the Fourier series being in Fourier space is novel and, thus, is not required to conform with the conventional meaning of Fourier analysis. Furthermore, the novel filtering aspect of the present invention is also not required to conform with conventional filtering. However, the filtering happens by chance to conform with a conventional understanding of filtering, as follows. The Fourier series in Fourier space taught by Appellant represents a spectral function that by definition has a corresponding inverse Fourier transform in the time domain. A derivation of an exemplary Fourier series in Fourier space of the present invention is disclosed in the Sub Appendix I, starting on page 55 of the application. Appellant teaches the multiplication of the Fourier series in Fourier space by the Fourier transform of a delayed Gaussian filter as disclosed on page 14, line 1 and the term Gaussian filter discussed above. This conforms with the conventional signal processing meaning of filtering as disclosed in Siebert, W. McC., Circuits, Signals, and Systems, The MIT Press, Cambridge, Massachusetts, (1986), pp. 364-384, cited on page 106 of the present application (Exhibit 4). A description of the novel filtering method of the present invention is described with reference to the term similarity between at least 2 filtered and unfiltered Fourier series discussed fully above. A derivation of the sampling and modulation of the Fourier series in Fourier space with the Fourier transform of a time delayed Gaussian filter according to the present invention is disclosed in Sub Appendix II, starting on page 60 of the application.

In sum, the Appellant submits that the easy-to-follow flow charts, the extensive written description, and supporting theory and mathematics in the Appendices, provides more than sufficient disclosure to enable one skilled in the art to make and use the invention as claimed without undue experimentation. Therefore, claims 51-322 fully comply with 35 U.S.C. § 112, first paragraph, and should be allowed.

III. **Claims 50-322 are patentable under 35 U.S.C. § 102(b) over Bates**

In the Office Action dated March 14, 2000, the Examiner rejected all claims 51-322 under 35 U.S.C. § 102, as being anticipated by Bates. Appellant respectfully submits that the Examiner's rejection is completely misplaced and that all claims 51-322 are patentable over Bates for the following reasons.

For a reference to anticipate under section 102, each and every limitation of the claim "'must be identically shown in a single reference.'" In re Bond, 15 USPQ 2d 1566, 1567 (Fed. Cir. 1990) (quoting Diversitech Corp. v. Centrum Steps, Inc., 7 USPQ 2d 1315, 1317 (Fed. Cir. 1988). To be sustainable, a rejection under Section 102 requires that the Examiner demonstrate how each element of each claim is identically shown in the cited reference.

Examiner Tadayon has failed to demonstrate how **any** element in any of the pending claims is shown in Bates. Examiner Tadayon's admitted excuse that he had insufficient time to adequately learn the invention due to his extensive training duties does not alleviate him of his duty to show how each an every element of Appellant's claims are anticipated by Bates, as required by Section 102.

Incredibly, Examiner Tadayon offers the following additional excuse for not providing a meaningful and complete anticipation rejection:

"Since the teaching of the specification is incomplete and inadequate, the claims are not fully supported by the specification, and the examiner cannot fully understand the meaning and scope of the claims. In view of

the 112-1st rejection mentioned above, a meaningful and complete comparison between the claims and prior art cannot be done."

This statement defies all logic and is an affront to the fair treatment patent applicant's have a right to expect in the conduct of the patent examination process. First, Examiner Tadayon bootstraps his admitted lack of time to adequately study the specification and lack of expertise in the field of artificial intelligence to allege that the disclosure is inadequate under 112, first paragraph, so as to sufficiently understand the invention. He then takes this bootstrap argument one step further by alleging that the claimed invention is anticipated by the prior art, but refuses to articulate his reasons why because the claimed invention is allegedly not adequately disclosed.

Put simply, Examiner Tadayon's "eleventh-hour" allegation that the specification is "incomplete and inadequate" - - after two years of examination by three Examiners and confirmation of allowability by the Section 101 panel of three senior Examiners - - is outrageous. As made clear from the preceding, extensive discussion of the disclosure in response to the Section 112 rejection, Appellant has gone far beyond the requirements of Section 112 by disclosing examples, flow charts and mathematical derivations in the Appendices and, thus, has provided a complete and adequate disclosure that would enable one skilled in the art to practice the invention without undue experimentation. Examiner Tadayon's assertion of incompleteness and inadequacy as a basis for rejecting claims as anticipated by Bates is wholly without merit and should itself be rejected out of hand.

Examiner Tadayon bases his Section 102 rejection upon a haphazard collection of key words and phrases from Bates, but fails to articulate any cogent explanation as to the meaning of these words and phrases or how they anticipate the elements of the presently claimed invention. His citation of various features of Bates that are not elements of the claimed invention, or otherwise required thereby, further demonstrate

his lack of familiarity with the subject matter of the present application and further
undermines the Section 102 rejection under consideration.

For example, Examiner Tadayon cites Bates for the proposition, "It can be used
for biomedical systems analysis, speech processing, and the like (column 1, lines 21-
28.)" The Examiner, however, fails to relate that passage to the context of the actual
disclosure in column 1, lines 16-25 of Bates:

> "The analysis and synthesizing of complex waveforms is a
> well developed art and has application to a large number of
> fields. For example, the analysis of acoustical signals
> having complex waveforms produced by one or more
> spaced sources is well known. Similarly, analysis of signal
> waveforms of electrical signals, seismic signals, and other
> signals is well known with application in speech processing,
> environmental sensing, biomedical, signal analysis, and the
> like."

From the context of the actual disclosure, it is apparent that the language in Bates
cited by the Examiner merely provides background that does not anticipate the present
invention. Nor does this background cover the general scope of the present invention, which
is capable of pattern recognition, generally referred to as "artificial intelligence," and which is
clearly distinguishable from the signal processing of Bates. Examiner's Tadayon's reliance
on certain catch phrases and words lifted from Bates is unfounded and cannot possibly form
the basis for anticipating Appellant's claims. For this reason alone, the Section 102 rejection
of all claims should be withdrawn.

Other passages in Bates cited by the Examiner make clear that this reference is
directed to subject matter divorced from the present invention. For instance, Examiner
Tadayon asserts that Bates, "describes wavelet, modulation, spectrum analysis, and spectral
pattern (column 5 lines 9-68.)" A careful reading of Bates at column 5, lines 9-11, however,
discloses that, "From the above, it is apparent that a crucial requirement for the analysis
system is that the system must identify the epoch τ_k as accurately as possible." In contrast,
the present invention has no such requirements. Further, in the present invention, no
periodicity of the data is required. Neither is the identification of the epoch (referring to time

of onset of a periodic function), which is a requirement of Bates. Bates' requirement of nulls in the data stream as a function of time is also not a requirement in the present invention. For these reasons alone, the Section 102 rejection of all claims should be withdrawn.

With respect to the Examiner's reliance on the term "modulation," Bates does not use that term in the section cited by Examiner Tadayon (column 5 lines 9-68). "Modulation" only appears in a publication referenced by Bates; no use of modulation is taught here. Specifically Bates discloses, (column 5 lines 23-35), "Therefore, each ripple in the waveform of FIG. 1 is a feature which results from either an excitation impulse or an oscillatory response. These features can be represented as real and complex zeros in the time domain as described, for example, in the publication by H. B. Voelcker, "Toward a Uniform Theory of Modulation," Part I: Phase-Envelop Relationships, IEEE Proceedings, Volume 54, March, 1966, pp. 340-353 and Part II, Zero Manipulation, IEEE Proceedings, May 1966, pp. 735-755. Also see U.S. Pat. No. 3,510,640 to H. B. Voelcker, entitled "Methods and Apparatus for Interpolation and Conversion of Signals Specified by Real and Complex Zeros"." Thus, Examiner Tadayon's reliance on the teaching of "modulation" in Bates is unfounded and should be withdrawn. For this reason alone, the Section 102 rejection of all claims should be withdrawn.

The Examiner further misapplies Bates, noting that, "It includes amplitude modulation circuits (column 32 lines 8-23.)" However, the use of modulation by Bates is with reference to a waveform synthesizer according to a composer program, which requires the features of periodicity, epoch, and zeros in the signal. Again, these feature are not requirements of the present invention and, thus, have no bearing on the patentability thereof. See column 31 lines 34-68. For this reason alone, the Section 102 rejection of all claims should be withdrawn.

The term "spectrum analysis" cited by Examiner Tadayon is also not disclosed in the section referenced by the Examiner. Bates in fact teaches that his signal processing method employs a non-spectral analysis approach. See column 2, lines 51-55. Furthermore, this term is irrelevant with respect to the present invention, since the claimed invention as recited in claims 51-117, 119, 127-155, 160-227, 229, 237-265, 271-280, 282, 288, 290-298, 301, 306 and 313-322 uses Fourier series in Fourier space and does not

require analysis of the spectrum determined from the data by a direct Fourier transform of the signal as a function of time. For this reason alone, the Section 102 rejection should be withdrawn.

Bates further teaches that his signal-processing invention does not utilize Fourier or spectral analysis (See column 1, lines 41-57) and further that his signal processing method employs a non-spectral analysis approach. See column 2, lines 51-55. Contrary to Bates, the claimed invention, as recited in claims 51-156, 160-266, 270-284, 290-298, and 304-322, relies on the use of Fourier series in Fourier space and, thus, could not possibly be anticipated by Bates. For this reason alone, the Section 102 rejection of these claims should be withdrawn.

Similarly, claims 51-117, 119, 127-155, 160-227, 229, 237-265, 271-280, 282, 288, 290-298, 301, 306 and 313-322 all recite the step of determining respective "spectral" similarities. Since Bates teaches his invention does not employ spectral analysis, these claims cannot be anticipated by Bates. For this reason alone, the Section 102 rejection of these claims should be withdrawn.

Examiner Tadayon also cites the term "spectral pattern," which is different from the term "spectral similarity" recited in claims 51-117, 119, 127-155, 160-227, 229, 237-265, 271-280, 282, 288, 290-298, 301, 306 and 313-322 . Bates, however, uses the term, "spectral pattern" with reference to the interpretation of his Equation (3) as "the instantaneous 'residue' of the spectral pattern of the signal f(t.)" and, thus, that term anticipates nothing in the presently claimed invention. (See column 5, lines 54-68.)

The pattern of "spectral analysis" as used by Bates refers to his method of searching for zeros in the data as a function of time to determine the periodicity and the epoch as compared to conventional methods of performing a Fourier transform on the data stream and analyzing the "pattern of a spectral envelop". (See column 34, line 63 to column 36, line 68.) Specifically, at column 34, lines 63-68, Bates discloses, "To demonstrate the advantages of the invention, there is next described a comparison of a waveform analysis by a novel invention, as compared to spectrum analysis techniques, and to explain and illustrate the ways by which the Aural Retina and Fourier analysis each obtain similar information for identifying a signal." In contrast, the present invention, as recited in all claims 51-322, does

not rely on performing a Fourier transform operation on a data stream, as do prior art methods. The present invention also does not require or determine the periodicity, epoch, and zeros by determining "vector measurements on each waveform zero" of the data, as required by Bates (column 36, lines 66-67). The present invention further does not require the determination of an autocorrelation to analyze a signal as a function of time to determine the periodicities, zeros, or epochs. For these reasons alone, the Section 102 rejection of all claims should be withdrawn.

Bates further teaches that "since the vector measurements taken at each waveform zero are independent, they can be treated by statistical procedures to accomplish the optimum detection processes that are usually associated with frequency domain techniques." See column 36, lines 66-68 and column 37, lines 1-2. Bates describes "the derivative or rate-of-change-vector" at column 5, line 54. "Vector measurements taken at each waveform zero" refers to a normalized derivative given by Equation (3) of a complex waveform given by Equation (1). Bates teaches "using the Periodicity Sorting Matrix, the zero samples can be established to identify periodicities, randomness, and epochs of time series." (See column 36 lines 19-22.) The present invention does not require "vector measurements at zeros according to Equation (3) of Bates. For this reason alone, the Section 102 rejection of all claims should be withdrawn.

Additionally, Bates does not teach the use of a probability expectation value, probability distribution or the use of probability operands as recited in claims 51-155, 157-265, 267-269, 271-303, 307-312 and 317-322. For this reason alone, the Section 102 rejection of these claims should be withdrawn.

Examiner Tadayon further cites Bates based on the premise that "[i]t deals with harmonic ripples, inference, and periodicity sorting matrix (column 37 lines 20-42.)" This passage, however, merely discloses a means to identify periodicity and epoch in the waveform comprising the signal as a function of time when multiple signals add or interfere in time. Again, the present invention does not require the searching for periodicity or epoch in the waveform comprising the signal as a function of time. The data may have no periodicity. For this reason alone, the Section 102 rejection of all claims should be withdrawn.

A further distinguishing feature is that Bates requires a data stream over time. The present invention does not require of a data stream over time. For this reason alone, the Section 102 rejection of all claims should be withdrawn.

For all of the foregoing reasons, Appellant submits that all claims 51-322 are patentable over Bates and should be allowed.

Conclusion

In view of the arguments presented herein above, all of the pending claims 51-322 fully comply with Sections 101, 112 and 102. Accordingly, Appellant respectfully requests that the Board withdraw the Examiner's rejections of claims 50-322 and allow all claims.

Respectfully submitted,

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